



DATA REPORT on Cancer in Children and Adolescents in Massachusetts, 2000-2009

Massachusetts Cancer Registry, Massachusetts Department of Public Health – June 2014

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TABLE OF CONTENTS

	<u>Page</u>
Executive Summary.....	2
Methods.....	4
Childhood and Adolescent Cancer Incidence and Mortality.....	8
Incidence by Year of Diagnosis and Sex.....	8
Mortality by Year of Death.....	10
Childhood and Adolescent Cancer Incidence by Age Group.....	11
Childhood and Adolescent Cancer Incidence by Race.....	13
Specific Types of Childhood and Adolescent Cancers.....	17
Leukemia.....	17
Lymphoma.....	22
Central Nervous System.....	25
Tumors of the Peripheral Nervous System.....	29
Malignant Epithelial Neoplasms.....	30
Soft Tissue Sarcomas.....	33
Germ Cell Tumors.....	35
Malignant Bone Tumors.....	37
Renal Tumors.....	39
Retinoblastoma.....	40
Hepatic (Liver) Tumors.....	40
Discussion.....	41
Appendices.....	43
Appendix I. International Classification of Childhood Cancer, 3 rd Edition (ICC-3).....	43
Appendix II. ICD-9 * and ICD-10* Codes.....	48
Appendix III. Massachusetts Childhood and Adolescent Cancer Counts, 2000-2009.....	49
References	53

* *International Classification of Diseases, Ninth Revision, Clinical Modification*

* *International Classification of Diseases, Tenth Revision, Clinical Modification*

EXECUTIVE SUMMARY

Data Report on Cancer in Children and Adolescents in Massachusetts, 2000-2009 presents cancer incidence and mortality data from 2000 through 2009 for children and adolescents (birth to 19 years) who were residents of Massachusetts at the time of diagnosis. This report updates the Massachusetts Cancer Registry's report, *Childhood Cancer in Massachusetts 1990-1999*, and provides information about the most common types of childhood cancer including differences by age, gender, and race/ethnicity. Time trends from 2000 to 2009 are analyzed and cancer-related deaths for both childhood (0-14) and adolescence (15-19) are detailed.

The decreased mortality rate of childhood/adolescent cancer has been one of the major success stories of medicine in the last 20 years. Although the overall death rate for these cancers did not decline significantly from 2000 to 2009, it did decrease significantly from 1990 to 2009 (see graph below for yearly death rates and the average annual change in death rate as indicated by the straight line). Consistent with national statistics, leukemia incidence rates increased significantly from 2000 to 2009. This increase was due in part to an increase in the rate of a specific subtype known as acute lymphocytic leukemia. As with overall childhood/adolescent mortality trend data in Massachusetts, the 20 year mortality trend for leukemia decreased significantly.

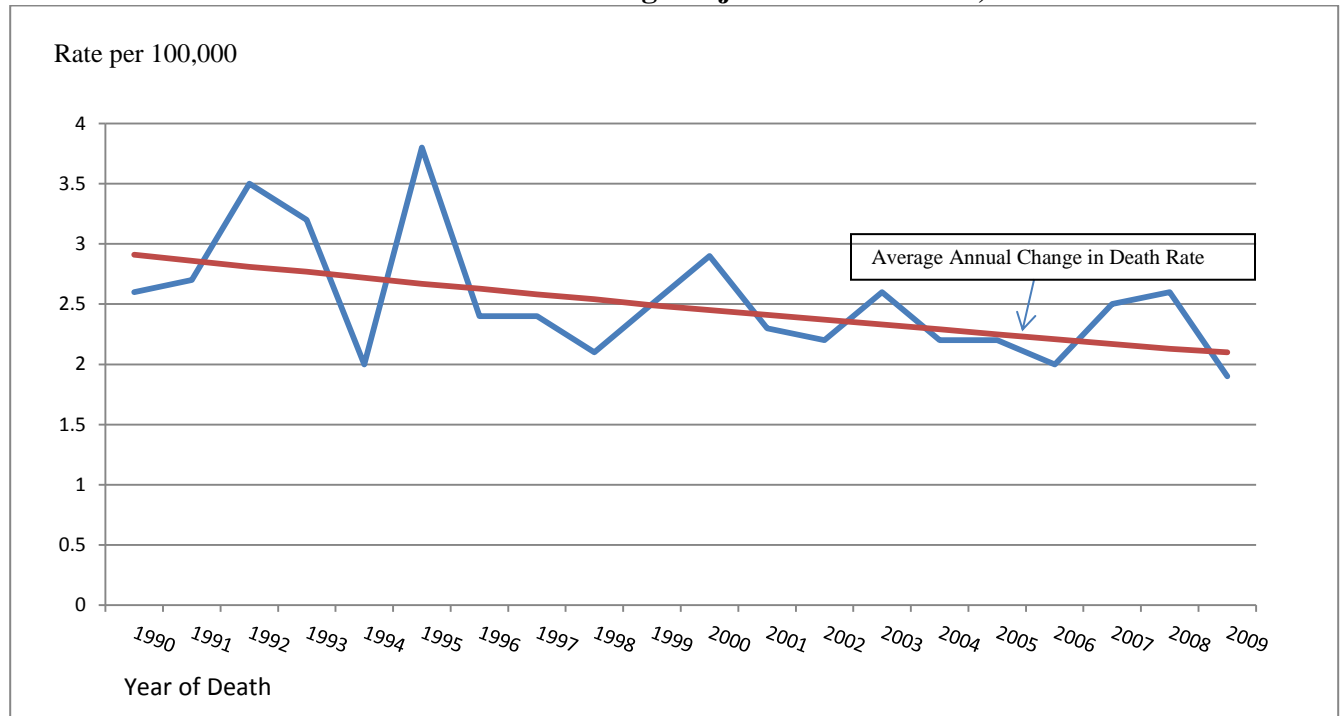
Public health and reports such as this one provide baseline tracking of the new cases (incidence) and mortality of diseases. Cancer is one of the top three reasons for childhood deaths. While progress is being made, continued surveillance over time for research and vigilance is needed to measure successes, and where there is opportunity to make an impact.

Data Highlights from the Report

- From 2000 through 2009, 3,001 invasive cancer cases were diagnosed among Massachusetts children and adolescents. The age-adjusted incidence rate of childhood invasive cancers declined non-significantly from 2000 to 2009 for both genders.
- Males represented 53.4% of all childhood/adolescent cancers and females 46.6%. The three most common cancers among males in this age group were leukemia (23.6%), cancers of the brain and central nervous system (CNS) (19.0%), and lymphoma (18.7%). Among females, they were leukemia (23.3%), cancers of the brain and CNS (18.3%), and malignant epithelial neoplasms (15.2%), the most common of which were thyroid cancer (8.0%) and melanoma (4.4%).
- Malignant epithelial neoplasm rates increased significantly from 2000 to 2009. Much of this increase can be attributed to a significant increase in thyroid cancer, likely due to better detection of smaller tumors (see *Data Report: Thyroid Cancer in Massachusetts* www.mass.gov/dph/mcr). Significantly more females than males were diagnosed with thyroid cancer and the majority of cases occurred in the 15-19 age group.

- From 2000-2009, cancer was ranked the 6th most common cause of death for children ages 0-4 (75 deaths, 1.7%), the 2nd most common for children ages 5-9 (86 deaths, 23.2%), the 2nd most common for children ages 10-14 (94 deaths, 18.8%), and the 2nd most common for adolescents ages 15-19 (131 deaths, 7.5%). Of the 386 cancer deaths among children and adolescents, the three most common were leukemia (29.4%), CNS cancer (23.2%), and adrenal gland cancer (9.8%).

Childhood and Adolescent Cancer Age Adjusted Death Rates, 1990-2009:



Source: Massachusetts Registry of Vital Records and Statistics and National Center for Health Statistics. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

METHODS

Sources of Incidence and Mortality Data:

The Massachusetts Cancer Registry (MCR): All Massachusetts incidence data are provided by the MCR, which is part of the Massachusetts Department of Public Health (MDPH). The MCR is a population-based registry that began collecting reports of newly-diagnosed cancer cases in 1982. The MCR collects reports of these cancer cases from health care facilities and practitioners throughout Massachusetts. Facilities currently reporting to the MCR in 2012 include 65 Massachusetts acute care hospitals, 6 radiation centers, 3 endoscopy centers, 4 surgical centers, 19 independent laboratories, 2 medical practice associations, 4 radiation/oncology centers and approximately 500 private practice physicians. Additionally, the MCR has reciprocal reporting agreements with 25 states to obtain data on Massachusetts residents diagnosed out of state. Currently the MCR collects information on *in situ* (except cervix) and invasive cancers and benign tumors of the brain and associated tissues. The MCR does not collect information on basal and squamous cell carcinomas of the skin. The MCR also collects information from reporting hospitals on cases diagnosed and treated in physician offices when this information is available. Not all hospitals report these physician office cases, however, some hospitals report such cases as if the patients had been diagnosed and treated by the hospital directly. Collection of these data makes the MCR's overall case ascertainment more complete. Some cancer types that may be reported to the MCR in this manner are melanoma, prostate, colon/rectum, and oral cancers. The MCR also identified and included cancers noted on death certificates that were not previously reported to the MCR.

To improve case completeness, this MCR report includes previously unreported cancer cases that have been discovered through death certificate clearance. This process identifies cancers mentioned on death certificates that were not previously reported to the MCR. In some instances, the MCR was able to obtain additional information on these cases through follow-up activities with hospitals, nursing homes and physicians' offices. In other instances, a cancer-related cause of death recorded on a Massachusetts death certificate is the only source of information for a cancer case. These "death certificate only" cancer diagnoses are, therefore, poorly documented, and have not been confirmed by review of complete clinical information. Such cases are included in this report, but they comprise less than 3% of all cancer cases for the years covered by this report.

Each year, the North American Association of Central Cancer Registries (NAACCR) reviews cancer registry data for quality, completeness, and timeliness. For diagnosis years 2000-2009, the MCR annual case count was estimated by NAACCR to be more than 95% complete each year. The MCR achieved the gold standard for this certification element, in addition to six other quality and timeliness elements for each year during 2000-2009.

Childhood cancers are classified differently from adult cancers. Whereas adult cancers are coded first using the cancer origin or primary site and then by histology, childhood cancers are predominately classified according to histology or tissue type regardless of primary site. The International Classification of Childhood Cancer, Third Edition (ICCC-3), based on the histology codes used in the International Classification of Diseases for Oncology, Third Edition (ICD-O-3), was developed to standardize the classification of childhood cancer cases.¹

Case reports for 2000 were coded following the International Classification of Diseases for Oncology, Second Edition (ICD-O-2) and converted to International Classification of Diseases for Oncology, Third Edition (ICD-O-3); ICD-O-2 was converted to ICD-O-3 in 2001. Cases reported from 2001 through 2009 were coded following the ICD-O-3 system. All cases diagnosed in children and adolescents were then grouped into International Classification of Childhood Cancer, Third Edition (ICCC-3) categories. The ICCC-3 system groups ICD-O-3 histology and site codes into 12 categories. Although the ICCC includes some tumors of benign or uncertain behavior in its classification of central nervous system and intracranial and intraspinal neoplasms, those tumors are not included in this report, which focuses on invasive Massachusetts cancers only.

Surveillance, Epidemiology, and End Results (SEER): National data on cancer incidence are from the National Cancer Institute's SEER Program, an authoritative source on cancer incidence and survival in the United States that collects and publishes data from registries in selected areas. The national cancer incidence data in this report include malignant cases from the 18 SEER areas (including Atlanta, Connecticut, Detroit, Hawaii, Iowa, New Mexico, San Francisco-Oakland, Seattle-Puget Sound, Utah, Los Angeles, San Jose-Monterey and Alaska, rural Georgia, greater California, Kentucky, Louisiana, New Jersey, and greater Georgia). SEER rates are presented per 100,000 persons and are age-adjusted to the 2000 United States standard population for ages 0-19 years. Please note that cases diagnosed in Louisiana from July to December 2005 were excluded as a result of Hurricane Katrina.²

Massachusetts Registry of Vital Records and Statistics (MVRs): Massachusetts death data were obtained from the MDPH's Registry of Vital Records and Statistics, which has legal responsibility for collecting reports of deaths of Massachusetts residents.

National Center for Health Statistics (NCHS): National mortality data were obtained from the Centers for Disease Control's National Center for Health Statistics, which collects national death data from individual state vital statistics registries. In contrast to national incidence data, mortality data include the entire United States.

Statistical Terms:

Age-Specific Rates – Age-specific rates were calculated by dividing the number of people in an age group who were diagnosed with cancer or died of cancer in a given time frame by the number of people in that same age group overall in that time frame. They are presented as rates per 100,000 residents and are cancer type and sex specific.

Age-Adjusted Rates – For most other MCR publications that focus on a specific cancer or cancers in the general population, age adjustment is based on 18 age groups (0-4, 5-9, 10-14, 15-19, etc. to 85+). The percentage that each age group comprised of the total United States 2000 population is multiplied by the age-specific rate for a cancer to obtain an adjusted rate. The age-adjusted rate for a specific cancer is derived by adding the 18 age group-specific rates into one age-adjusted rate. Age adjustment controls for age differences in cancer incidence. For this report, age adjustment was based on the first four age groups (0-4, 5-9, 10-14, and 15-19). The population percentages of each of these four groups were derived from the US 2000

population. From this derivation, age-adjusted cancer rates for 0-19 year olds were calculated in the same manner as the age adjustment for the 18 age groups. Age-adjusted rates can only be compared if they are adjusted to the same standard population.

Joinpoint Regression Analysis of Cancer Trends – The annual percent change (APC) $=100*(e^m-1)$, where m is a slope of the linear regression line, which is an approximation of the function of the natural logarithm of the rates by the year of diagnosis. The APC is a linear approximation; therefore, it may not give an accurate picture of long-term trend. SEER provides software to calculate the number and location (in time) of points where trends change direction (joinpoints).³ At each joinpoint, the trend may change in different ways. The joinpoint regression model describes the trend as a sequence of linear segments between corresponding joinpoints so that each segment has an associated APC positive trend, negative trend, or no trend.

Proportion Comparisons – Proportions were compared for significance using the modified Wald Method on graph pad software <http://graphpad.com/quickcalcs/confInterval1/>. Significance for rate comparisons was determined by comparing the 95% confidence intervals for two rates. If the intervals overlapped, the difference between the rates was not considered to be statistically significant. If, however, there was no overlap between the confidence intervals, then the difference in rates was considered to be statistically significant. For the sake of brevity, all statistically significant differences in this report will be referred to as being significantly different and not statistically significantly different.

Survival - The calculation of minimum five-year survival time was limited to Massachusetts and US SEER cases diagnosed from 2000 to 2004 since mortality data were available only through 2009. Survival analyses were done only for those cancers with 20 or more incident cases from 2000 to 2004. Cumulative five-year survival times were calculated using the life table or actuarial method whereby only cancer specific causes of death were used as an endpoint and all other causes of death were censored, or excluded from analyses. Survival rates were computed for each of the 5-year periods and then multiplied to obtain a cumulative survival rate. For example, if 96.8% survived the first year, 94.6% the second year, 93.2% the third year, 96.3% the fourth year, and 98.7% the fifth year, the five-year cumulative survival would be .968 x .946 x .932 x .963 x .987, or 81.1%. The SEER survival data presented are also cause-specific and computed by the actuarial method.⁴

Population Estimates:

All of the population estimates used in this report were produced by the NCHS in collaboration with the Census Bureau's Population Estimation Program. The NCHS reallocates the multiple race categories from the Census Bureau population estimates file to create four mutually exclusive race categories that are consistent with the race categories used to collect cancer incidence and cancer mortality data for the years 2000-2009.

Race/Ethnicity:

The race/ethnicity categories presented in this report are mutually exclusive. Cases and deaths are only included in one race/ethnicity category. The race/ethnicity tables include the

categories white, non-Hispanic; black, non-Hispanic; Asian, non-Hispanic; and Hispanic. The total population in Massachusetts also includes unknown races/ethnicities and Native Americans. As a result, the number of cases for the total population is not the sum of cases by race/ethnicity.

Data Limitations:

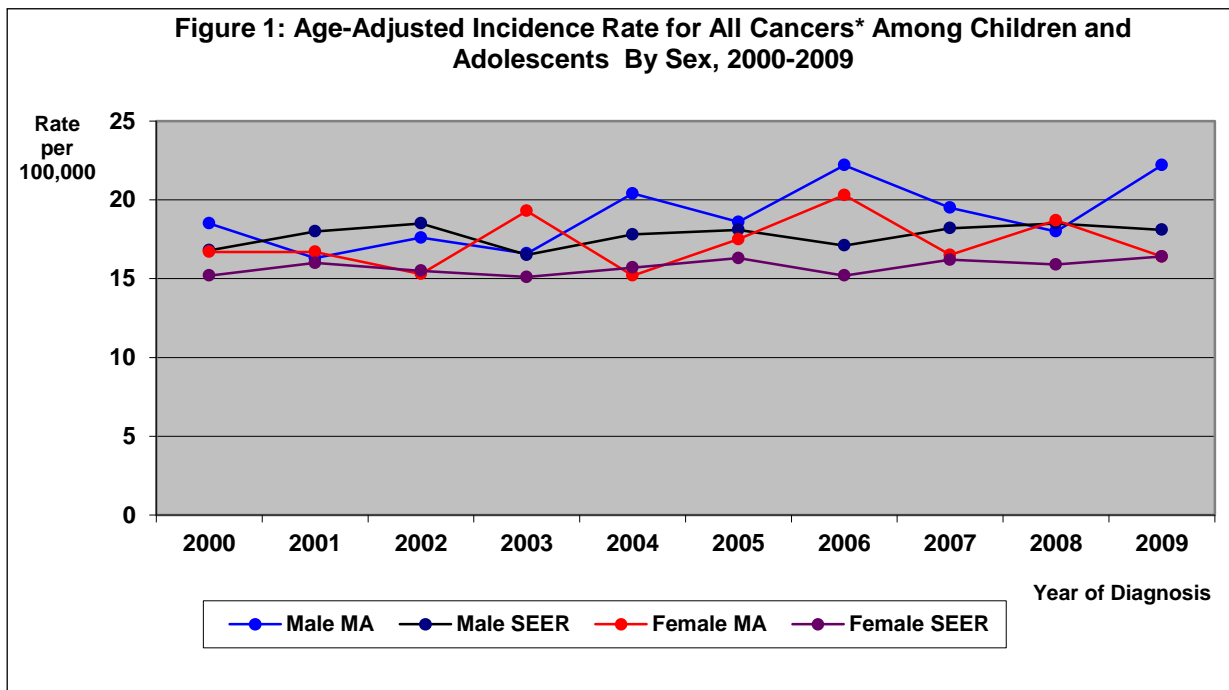
When interpreting the cancer data, it is important to consider certain limitations which include:

- Under-reporting in areas close to neighboring states: Although the MCR has reciprocal reporting agreements with 25 states, including all New England states, there may still be some Massachusetts residents who were diagnosed out of state and not reported to the MCR
- Potentially misleading trends: Apparent increases or decreases in cancer incidence over time may reflect changes in diagnostic methods or case reporting rather than true changes in cancer occurrence.
- Small numbers of cases: Many of the calculations in this report involved small numbers of cases. As a result, differences in rates may be due to chance, and the data should be interpreted with caution.
- Misclassification and/or under-reporting of racial/ethnic data: Data on race/ethnicity are based on information existing in the medical record for cancer cases and information on the death certificate for cancer deaths. Errors in these source documents may lead to incorrect classification of race/ethnicity.

CHILDHOOD AND ADOLESCENT CANCER INCIDENCE AND MORTALITY

Incidence:

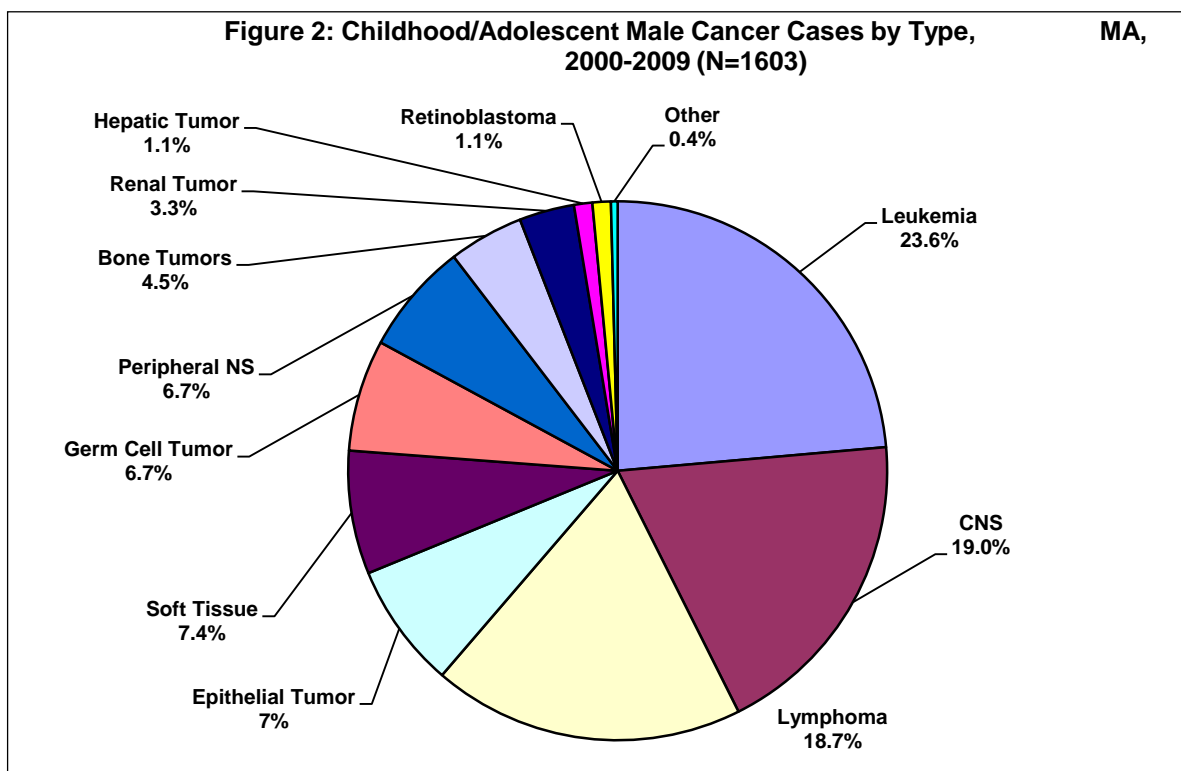
From 2000-2009, there were 3,001 invasive cancer cases diagnosed among Massachusetts children and adolescents through the age of 19. For both males and females, the age-adjusted incidence of all cancers combined among children and adolescents did not change significantly from 2000-2009, with annual percent changes (APC) of 1.0% and 0.8%, respectively. Nationally, US SEER incidence rates for male and female children and adolescents also showed non-statistically significant increases (APC of 0.5% for both sexes) (Figure 1).



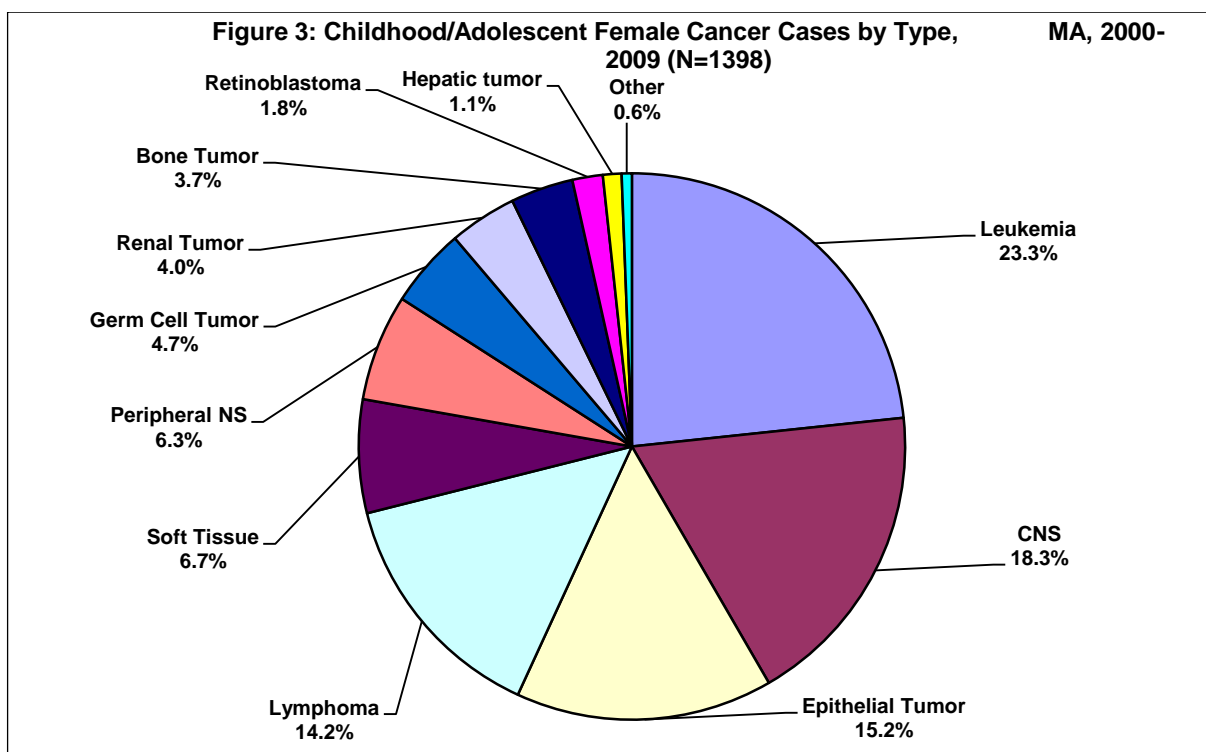
Source: Massachusetts Cancer Registry and SEER 18 Registries. *Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Massachusetts males represented 53.4% of the cancer cases and females 46.6% (Figures 2 and 3). The three most common cancers diagnosed among male Massachusetts children and adolescents from 2000 to 2009, accounting for 61.3% of all cases, were leukemia, cancers of the brain and central nervous system, and lymphoma. The three most common of these cancers for females, accounting for 56.8% of all cases, were leukemia, cancers of the brain and central nervous system (CNS) and malignant epithelial neoplasms. The most common epithelial neoplasms were thyroid cancer (8.0% of all cases) and melanoma (4.4% of all cases). No other grouping accounted for more than 10% of childhood and adolescent cancer in either sex.

Nationally, males represented 54.3% of childhood and adolescent cancers diagnosed from 2000 to 2009 and females represented 45.7%. The three most common of these cancers for males were leukemia, lymphoma, and CNS cancer, representing 60.8% of all cancers. Nationally, the three most common of these cancers for female children and adolescents were leukemia, brain and CNS cancer, and malignant epithelial neoplasms, representing 57.1% of all cancers. Lymphoma, representing 12.7% of female cancers, ranked fourth.



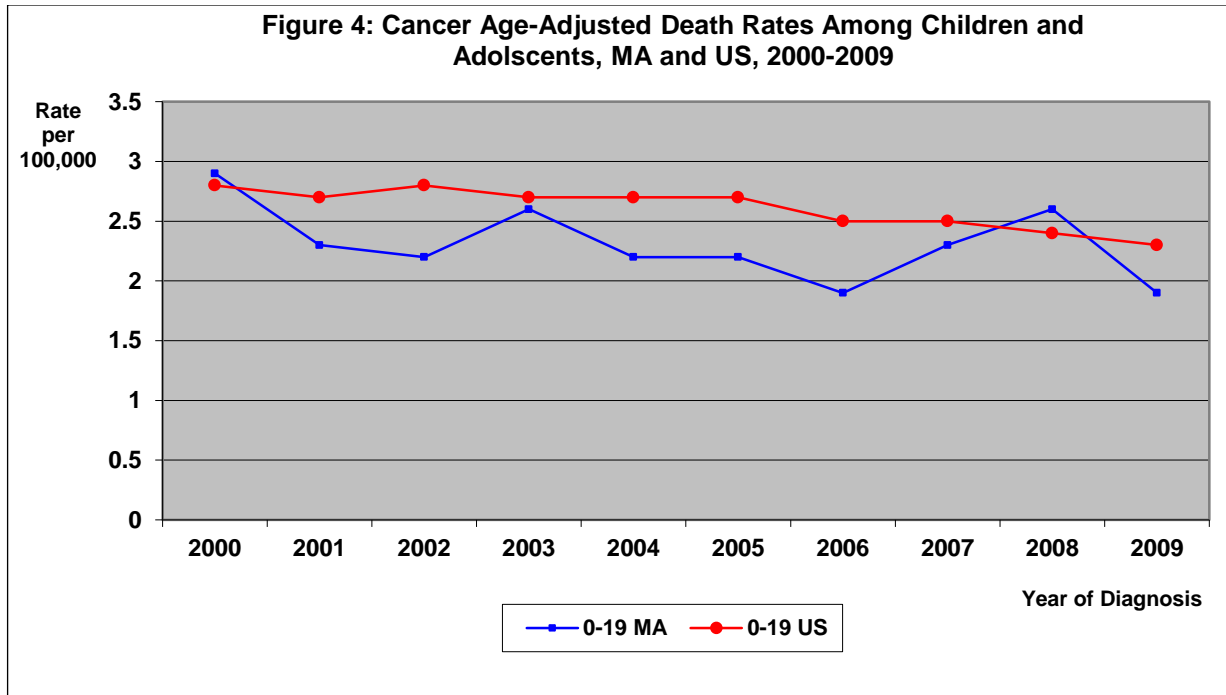
Source: Massachusetts Cancer Registry



Source: Massachusetts Cancer Registry

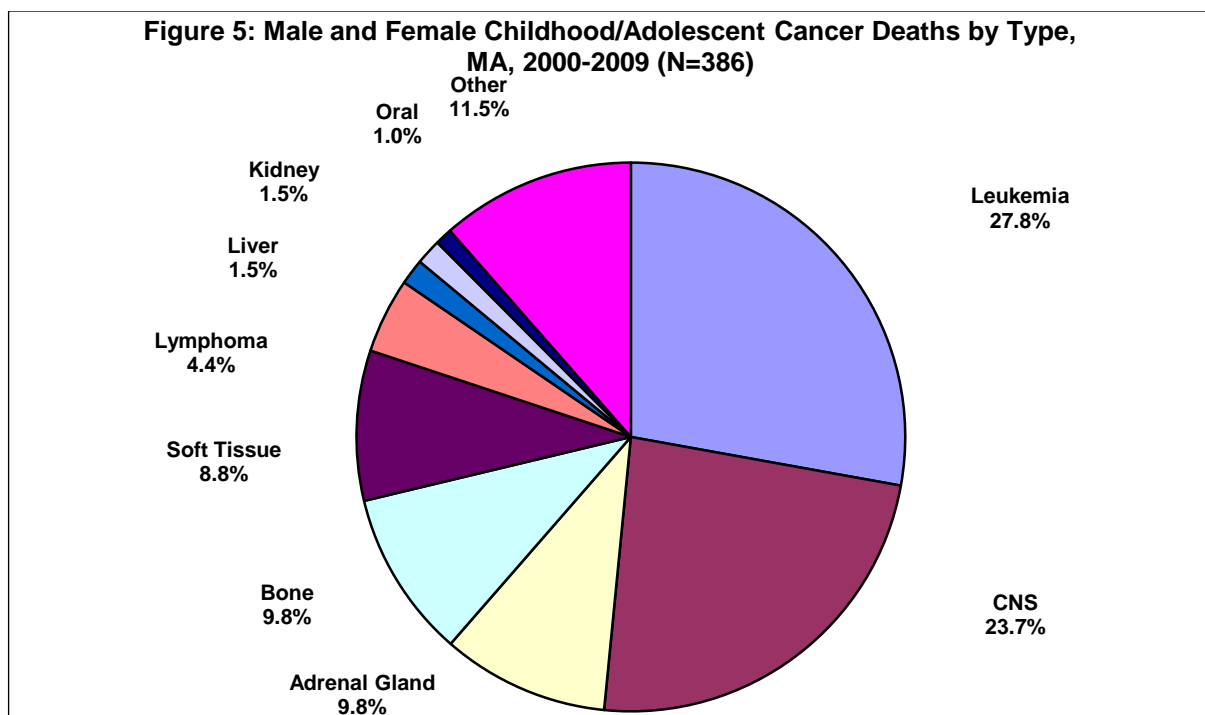
Mortality:

From 2000-2009 in Massachusetts, cancer was ranked the 6th most common cause of death for children ages 0-4 (75 deaths, 1.7%), the 2nd most common for children ages 5-9 (86 deaths, 23.2%), the 2nd most common for children ages 10-14 (94 deaths, 18.8%), and the 2nd most common for adolescents ages 15-19 (131 deaths, 7.5%). During this time period, there were 386 deaths with cancer as an underlying cause of death among children and adolescents. Since the number of deaths was small, Massachusetts death data were not broken down by sex. The national death data were not broken down by sex to be consistent with Massachusetts data. The death rate has been decreasing with an APC of -2.2% for Massachusetts and -2.0% for the United States. The trend, however, was only statistically significant for national statistics. The 20-year trend in Massachusetts from 1990 to 2009 (not pictured), however, indicated a statistically significant decrease (APC=-1.8%) in cancer deaths among children and adolescents.



Source: Massachusetts Registry of Vital Records and Statistics and National Center for Health Statistics. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

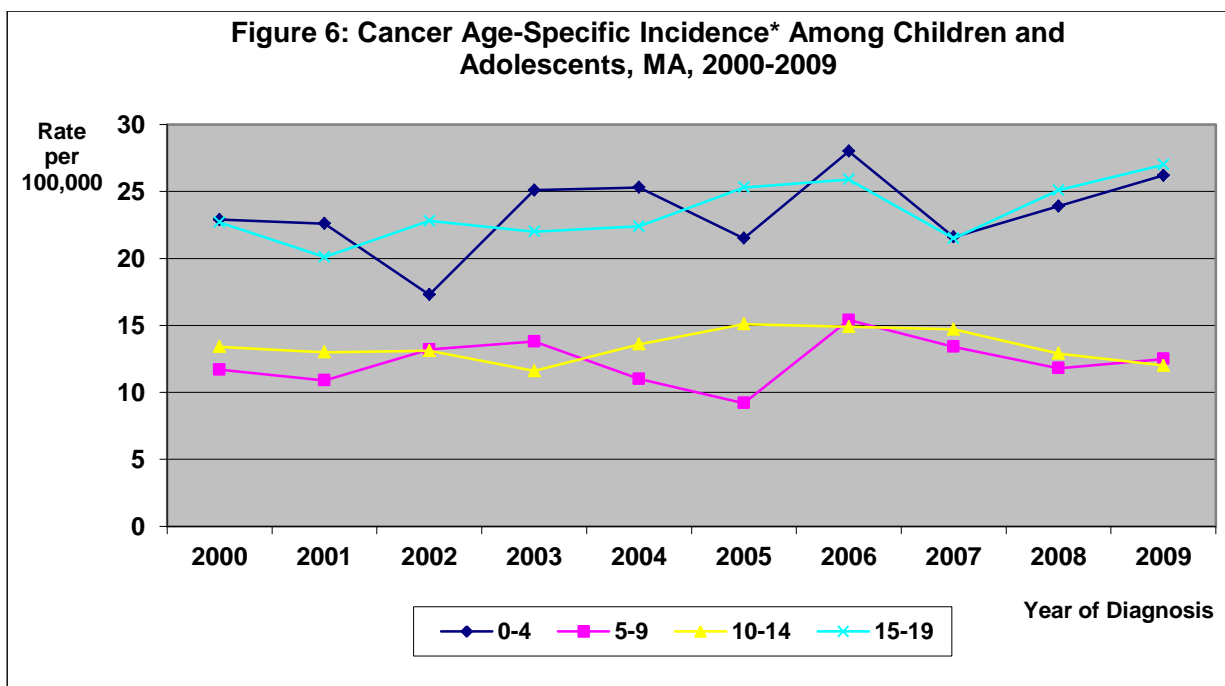
Leukemia accounted for 27.8% of cancer deaths among Massachusetts children and adolescents of both sexes from 2000-2009, the leading cause of death from cancer for this group. Central nervous system cancer was second and accounted for 23.7% of deaths. Cancers of the adrenal gland (related to neuroblastoma), bone, and soft tissue comprise the top five causes of death from cancer, accounting for 9.8%, 9.8%, and 8.8% of deaths, respectively (Figure 5).



Source: Massachusetts Registry of Vital Records and Statistics.

CHILDHOOD AND ADOLESCENT CANCER INCIDENCE BY AGE GROUP:

When analyzing age-specific rates, children under the age of 5 and adolescents ages 15 to 19 had higher cancer rates than those ages 5 to 14. The age group 15-19 was the only age group displaying a significantly increasing trend with an APC of 2.1% (Figure 6).



Source: Massachusetts Cancer Registry.

Table 1: Age-specific incidence rates and 95% confidence intervals of leading cancers among children and adolescents by age group and sex, Massachusetts, 2000-2009

Age 00-04 years			Age 05-09 years		
Rank	Males	Females	Rank	Males	Females
	All Cancers 23.1 (20.9, 25.2)	All Cancers 23.7 (21.6, 26.0)		All Cancers 13.6 (12.0, 15.2)	All Cancers 10.9 (9.5, 12.4)
1	Leukemia 8.0 (6.7, 9.2)	Leukemia 9.0 (7.6, 10.3)	1	Central Nervous System 4.6 (3.7, 5.5)	Central Nervous System 3.5 (2.7, 4.4)
2	Central Nervous System 4.6 (3.6, 5.5)	Central Nervous System 4.7 (3.7, 5.7)	2	Leukemia 3.6 (2.7, 4.4)	Leukemia 3.0 (2.2, 3.7)
3	Peripheral Nervous System 4.3 (3.4, 5.2)	Peripheral Nervous System 3.8 (2.9, 4.7)	3	Lymphoma 2.4 (1.7, 3.0)	Soft Tissue Sarcomas 1.0 (0.5, 1.4)
4	Renal Tumors 1.8 (1.2, 2.3)	Renal Tumor 1.7 (1.1, 2.3)	4	Soft tissue sarcoma 0.9 (0.5, 1.3)	Renal Tumor 0.9 (0.5, 1.3)
5	Soft Tissue Sarcoma 1.3 (0.8, 1.9)	Retinoblastoma 1.3 (0.7, 1.8)	5	Renal Tumor 0.6 (0.3, 0.9)	Lymphoma 0.7 (0.3, 1.1)

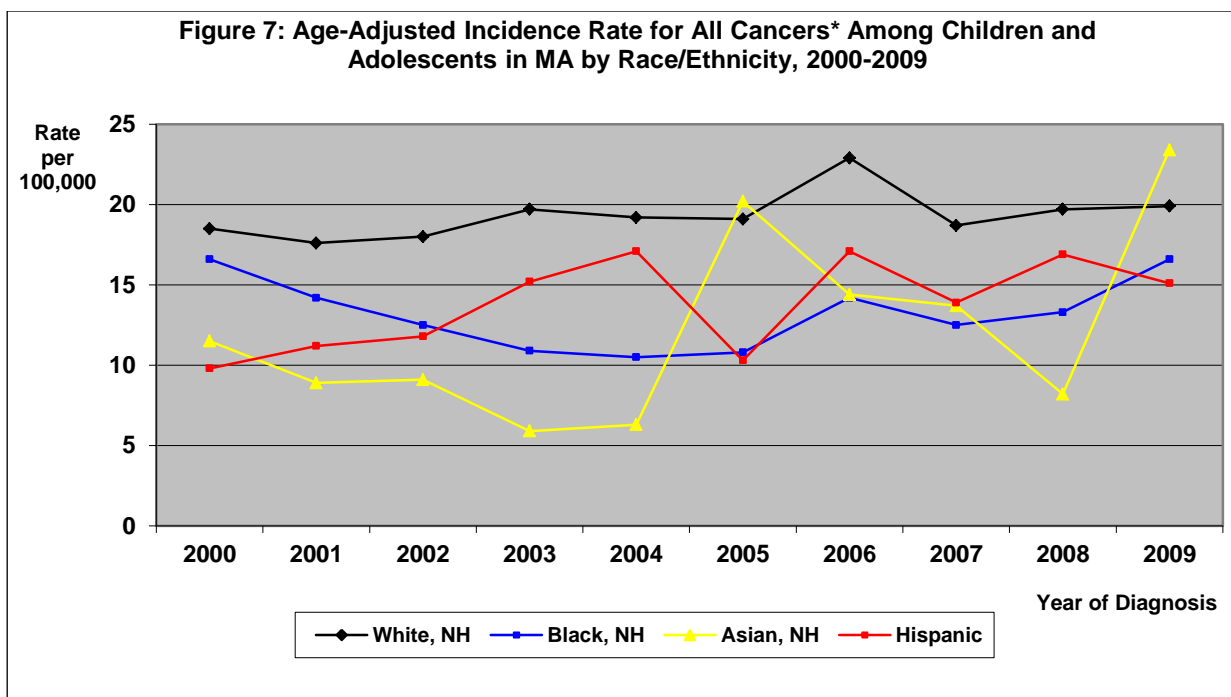
Age 10-14 years			Age 15-19 years		
Rank	Males	Females	Rank	Males	Females
	All Cancers 14.4 (12.8, 16.0)	All Cancers 12.4 (10.9, 13.9)		All Cancers 25.2 (23.1, 27.2)	All Cancers 22.4 (20.4, 24.4)
1	Lymphoma 4.2 (3.3, 5.0)	Central Nervous System 2.5 (1.8, 3.2)	1	Lymphoma 6.6 (5.5, 7.7)	Epithelial Tumor 7.8 (6.6, 9.0)
2	Leukemia 3.1 (2.4, 3.8)	Lymphoma 2.5 (1.8, 3.2)	2	Germ cell 4.0 (3.2, 4.9)	Lymphoma 5.8 (4.8, 6.8)
3	Central Nervous System 2.8 (2.1, 3.5)	Leukemia 2.3 (1.7, 3.0)	3	Epithelial Tumor 4.0 (3.2, 4.9)	Leukemia 2.3 (1.7, 2.9)
4	Bone 1.5 (1.0, 2.0)	Epithelial Tumor 1.9 (1.3, 2.5)	4	Leukemia 3.6 (2.8, 4.4)	Central Nervous System 2.2 (1.5, 2.8)
5	Epithelial Tumor 1.2 (0.8, 1.7)	Bone 1.1 (0.6, 1.5)	5	Central Nervous System 2.8 (2.1, 3.5)	Soft Tissue Sarcoma 1.7 (1.2, 2.3)

Source: Massachusetts Cancer Registry.

The age-specific incidence rate of childhood cancer was highest among Massachusetts males 15-19 years old and for females 0-4 years old (Table 1). The rates for both males and females in these two groups were both statistically significantly elevated when compared to males and females of the other two groups (5-9 and 10-14). The most common cancers among children and adolescents varied by age group and sex. Leukemia ranked number one among 0-4 year olds for both males and females, with significantly higher rates than any other cancer in this age group. Central nervous system tumors ranked number one among 5-9 years old for both males and females. Lymphomas ranked number one for males and central nervous system tumors rank number one for females in the 10-14 years old group. Lymphomas ranked number one for males and malignant epithelial neoplasms ranked number one for females in the 15-19 years old group who had a significantly higher rate of epithelial tumors compared to males. The rate of all cancers among females in Massachusetts aged 0-4 was significantly elevated compared to the SEER rate (23.7, CI=21.6-26.0 vs. 19.5, CI=19.0-20.1). Additionally, the lymphoma rate among males in Massachusetts aged 10-14 was significantly elevated compared to the national rate (4.2, CI=3.3-5.0 vs. 3.0, CI=2.8-3.2). Otherwise, there were no significant differences between Massachusetts and SEER rates.

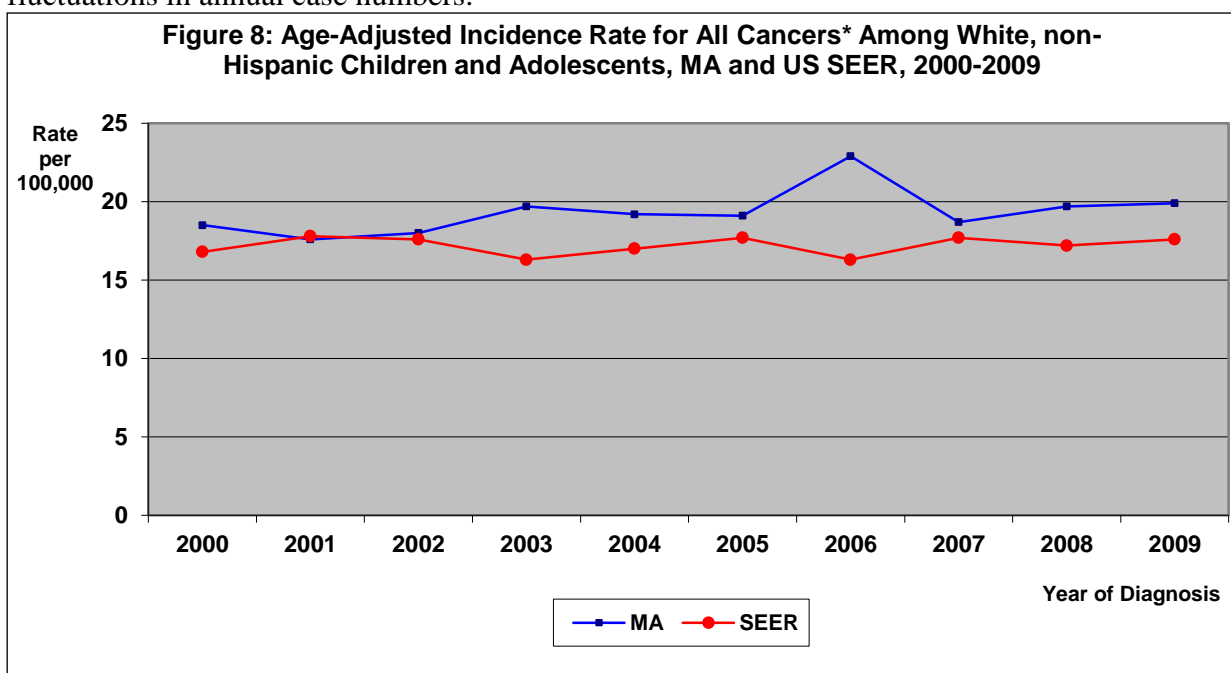
CHILDHOOD AND ADOLESCENT CANCER INCIDENCE BY RACE:

The following five figures compare childhood and adolescent cancer incidence trends by race and ethnicity. The first figure (Figure 7) compares the incidence trends from 2000-2009 for the four major racial/ethnic groups in Massachusetts. The rates for white, non-Hispanics (NH) and Asian, NHs increased non-significantly with APCs of 1.3% and 7.4%, respectively. The incidence rate for black, NHs decreased significantly with an APC of -11% from 2000-2004 and then increased significantly with an APC of 9.1% from 2005-2009. The incidence rate for Hispanics increased significantly with an APC of 4.6% from 2000-2009. It should be noted that, with the exception of the white, NH case numbers (n=2387), the other numbers were small and had less stable rates (black, NH=175, Asian, NH=108, Hispanic=272). For example, when there are 6 cases in a given year, an increase of even 2 or 3 cases the following year can possibly indicate a trend when there isn't one, especially if the number falls back to 5 the following year.

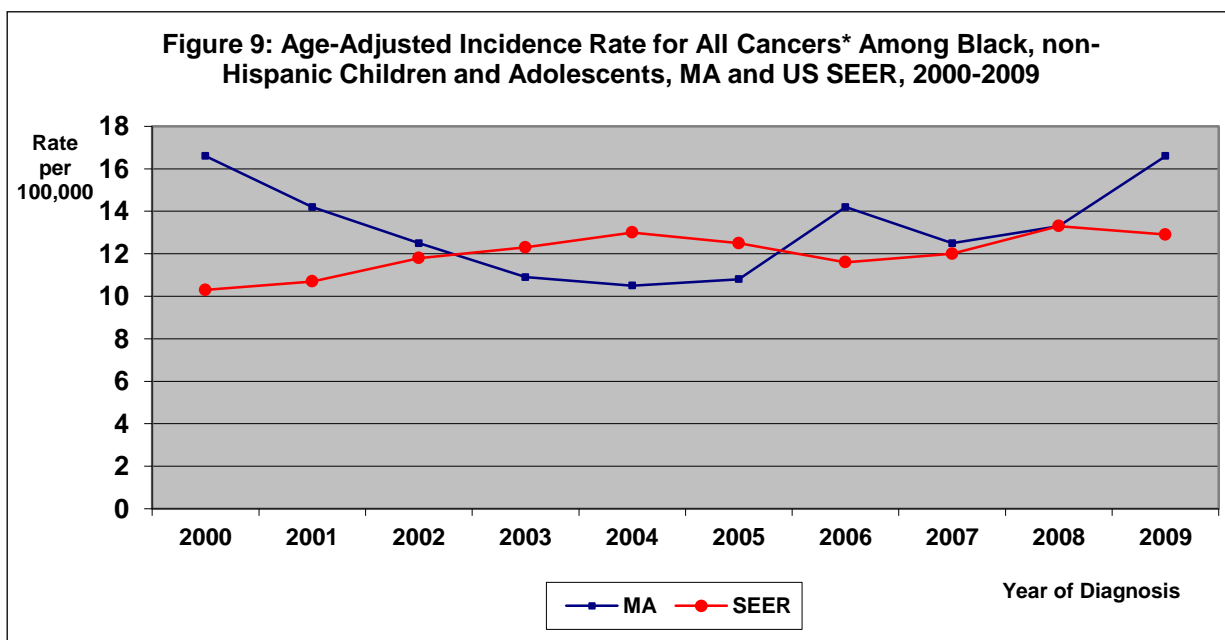


Source: Massachusetts Cancer Registry. * Rates are age-adjusted to the US standard 2000 population for ages 0-19

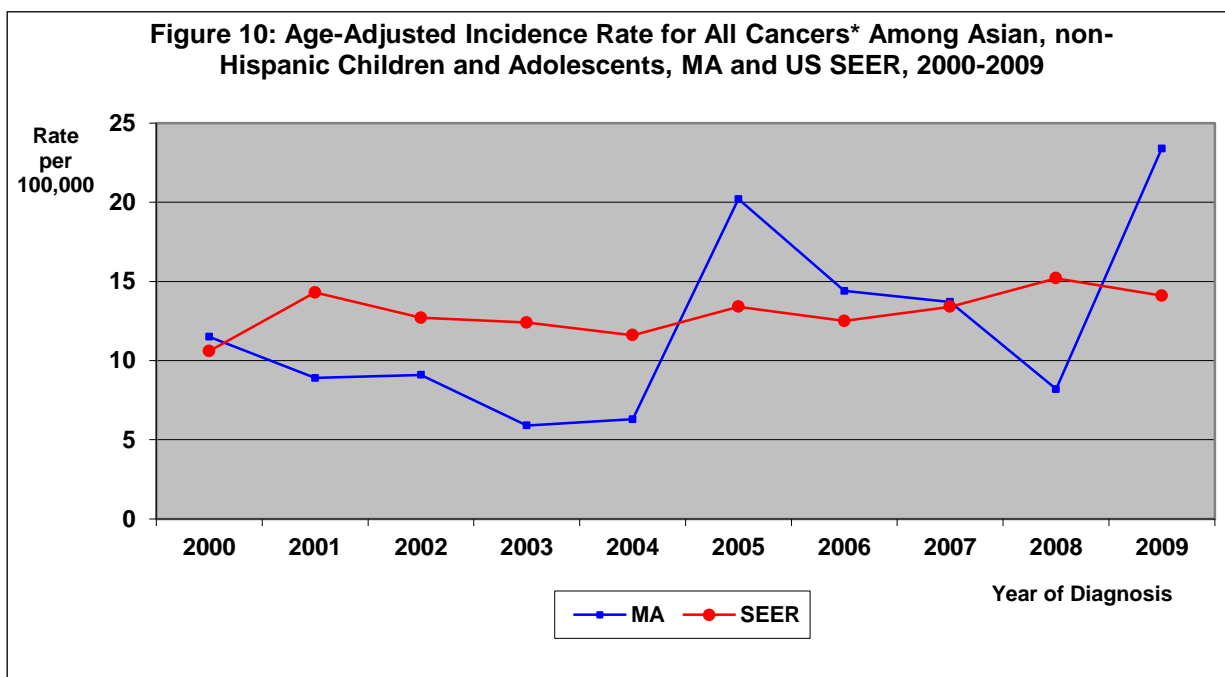
Nationally, the incidence rates for white, NHs, increased non-significantly with an APC of 0.1% (Figure 8). For black, NHs the trend increased with a significant APC of 2.0% (Figure 9); for Asian, NHs the trend increased non-significantly with an APC of 2.0% despite some annual fluctuations (Figure 10); and for Hispanics the trend increased significantly with an APC of 1.3% (Figure 11). As opposed to the state trends for black, NHs, Asian, NHs, and Hispanics, the national numbers were much larger and as a result, the trends are less subject to small fluctuations in annual case numbers.



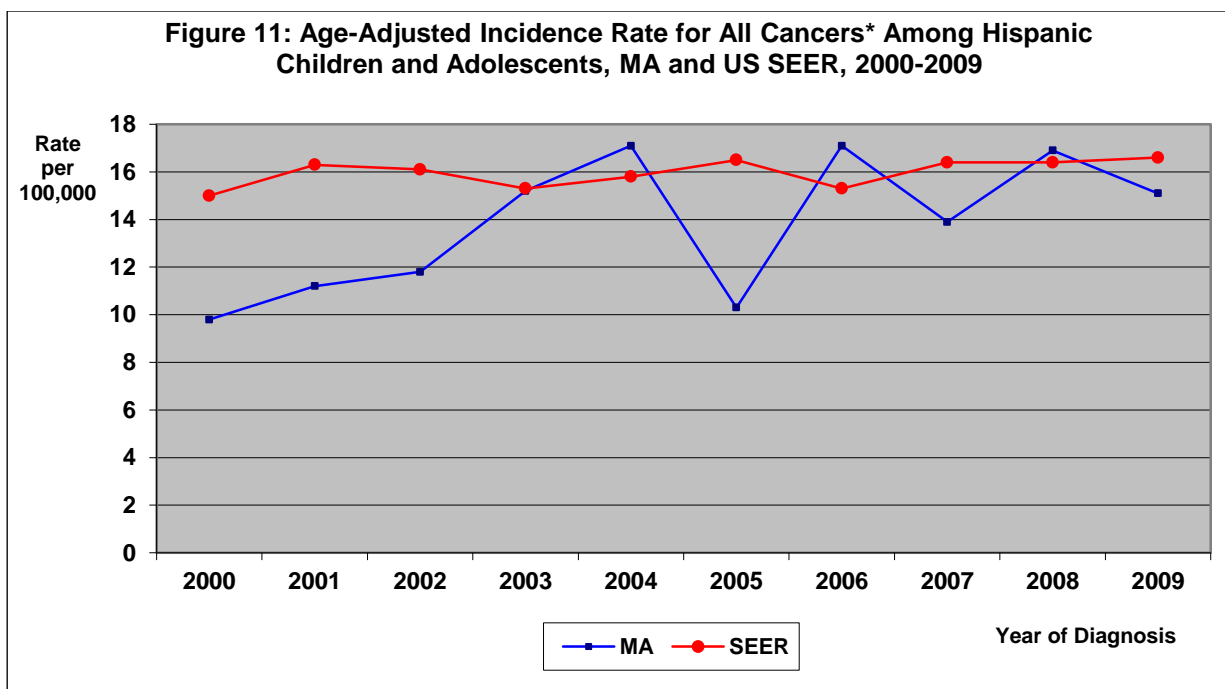
Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19

From 2000-2009, Massachusetts white, NH children and adolescents had a significantly higher age-adjusted incidence rate for all cancers combined and CNS cancers compared to the three other racial/ethnic groups (Table 2). There were no significant differences between black, NHs, Asian, NHs, and Hispanics. Of the five leading cancers for each racial/ethnic group, three were the same (leukemia, CNS and Lymphoma) but differed in the ranking. When compared to the national SEER rates, the rate of all cancers among Hispanics was significantly lower (14.0, CI=12.4-15.7 vs. 16.5, CI=16.1-16.8). Otherwise, there were no significant differences in rates between Massachusetts and the nation.

Table 2: Age-Adjusted Incidence rates and 95% Confidence Intervals of the top five cancers among children and adolescents by race/ethnicity, Massachusetts, 2000-2009

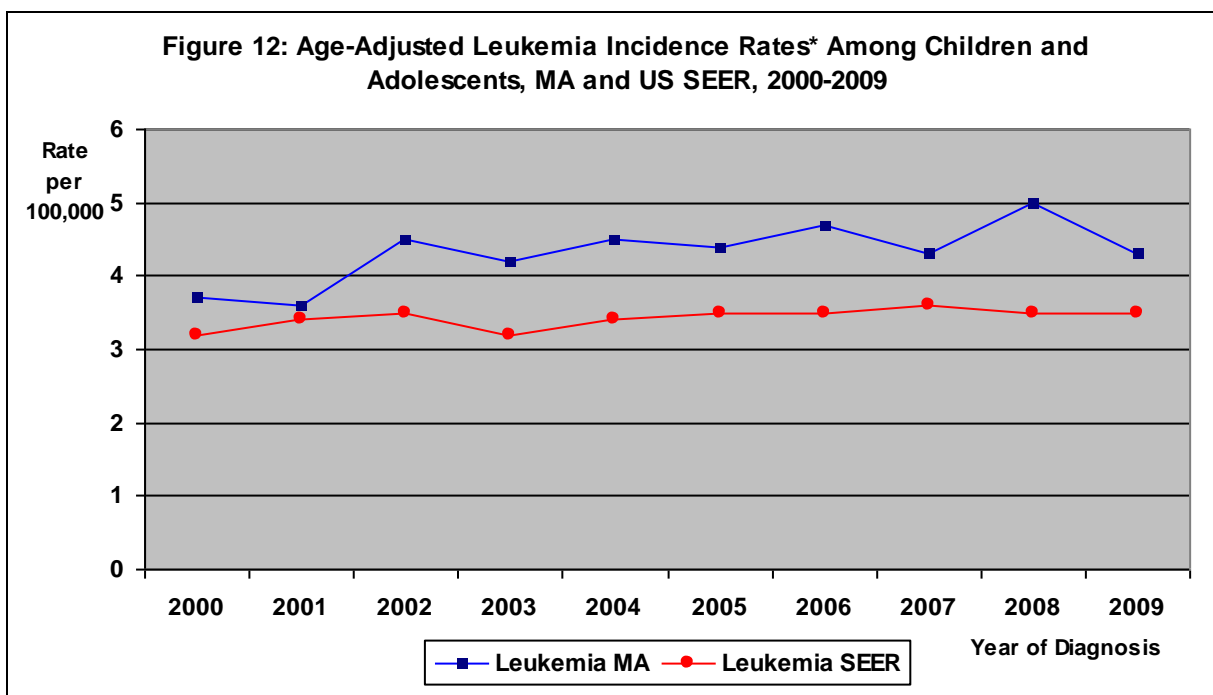
rank	White, NH	Black, NH	Asian, NH	Hispanic
	All Cancers 19.3 (18.5, 20.1)	All Cancers 13.2 (11.3, 15.2)	All Cancers 12.4 (10.1, 14.7)	All Cancers 14.0 (12.4, 15.7)
1	Leukemia 4.6 (4.2, 5.0)	Lymphoma 2.6 (1.8, 3.5)	Leukemia 3.5 (2.3, 4.8)	Leukemia 4.1 (3.2, 5.0)
2	Brain/Central Nervous System 3.8 (3.5, 4.2)	Leukemia 2.5 (1.6, 3.3)	Lymphoma 2.2 (1.2, 3.3)	Brain/Central Nervous System 2.3 (1.7, 3.0)
3	Lymphoma 3.1 (2.8, 3.4)	Central Nervous System 1.8 (1.0, 2.5)	Central Nervous System 2.1 (1.2, 3.3)	Lymphoma 2.3 (1.6, 3.0)
4	Epithelial Tumors 2.0 (1.8, 2.3)	Soft Tissue Sarcoma 1.7 (1.0, 2.4)	Soft Tissue Sarcoma 1.0 (0.3, 1.6)	Epithelial Tumors 1.4 (0.8, 1.9)
5	Peripheral Nervous System 1.4 (1.2, 1.6)	Renal Tumors 0.9 (0.4, 1.4)	Germ Cell Tumors 0.8 (0.2, 1.4)	Soft Tissue Sarcoma 1.1 (0.6, 1.6)

Source: Massachusetts Cancer Registry. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

SPECIFIC TYPES OF CHILDHOOD AND ADOLESCENT CANCERS:

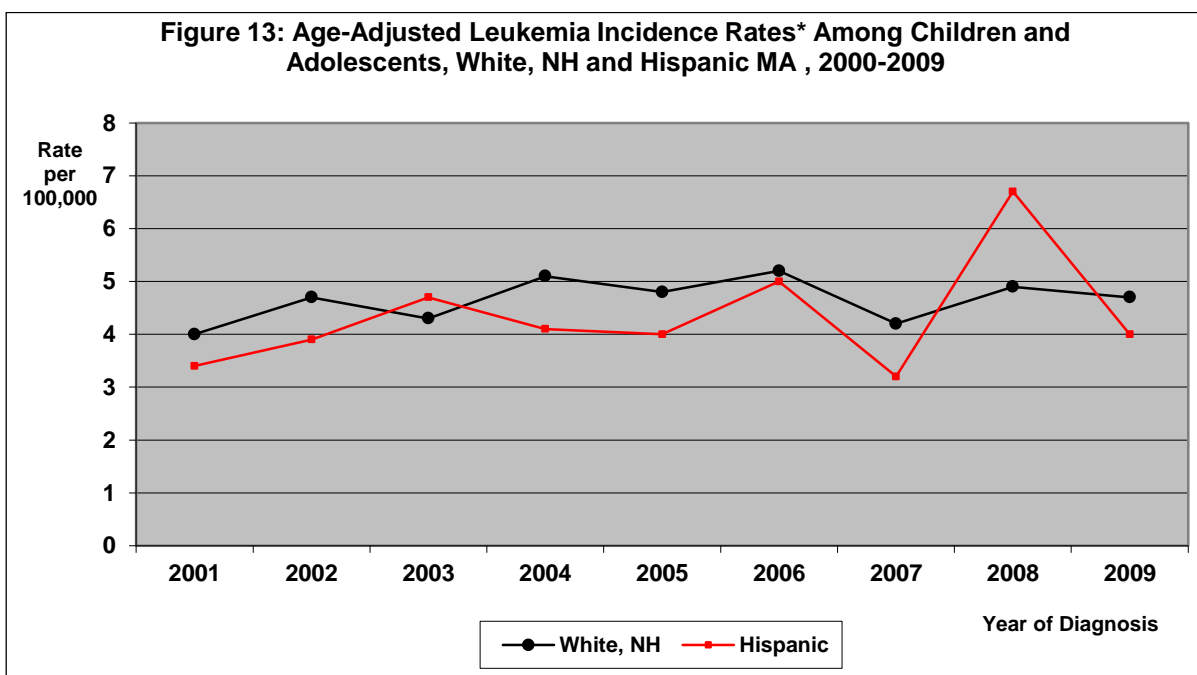
LEUKEMIA

Leukemia is a general term that includes different cancers that occur in the bone marrow, which is responsible for supplying blood cells. Any cell in the bone marrow can transform into a leukemia cell which can reproduce quickly and not die when it should. The cells build up in the bone marrow and eventually enter the bloodstream.⁵ From 2000-2009, the 705 leukemia cases accounted for 23.5% of Massachusetts childhood and adolescent cancer cases compared with 26.7% of US SEER cases. Figure 12 shows the trends in total leukemia incidence by age group from 2000-2009. There was a significant increase in the incidence trend for childhood and adolescent leukemia in MA (APC=2.3%) but not in the US (APC=1.0%).



Source: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

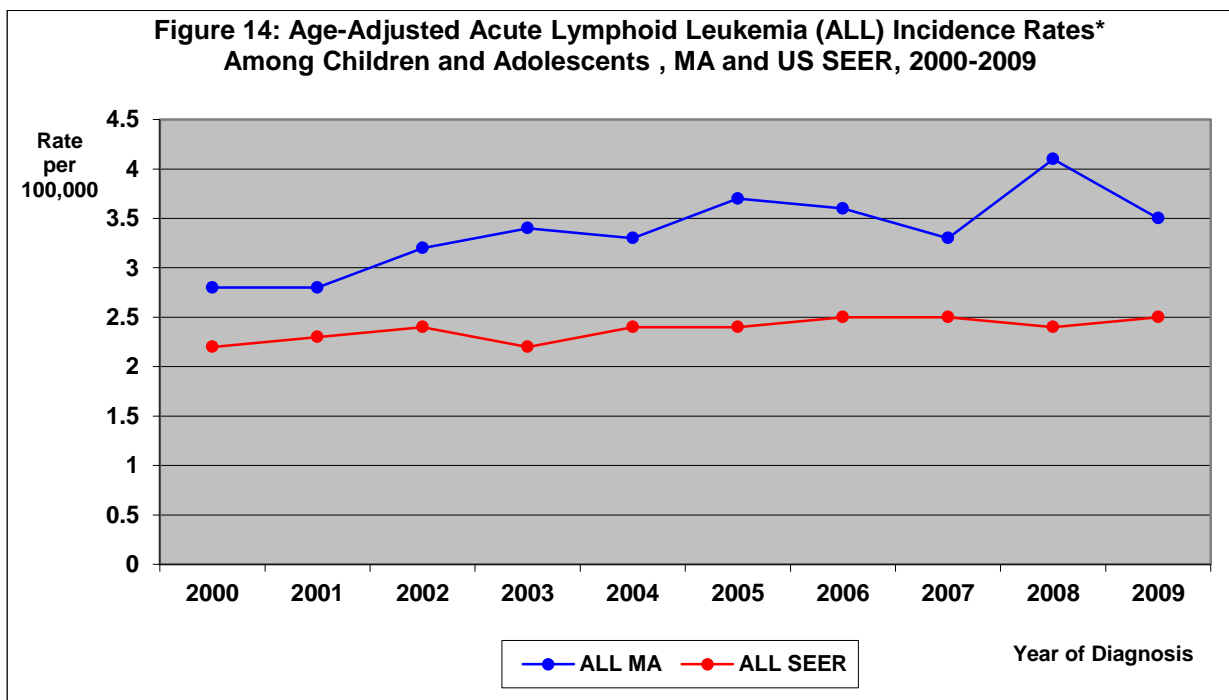
Trends in leukemia incidence were compared between white, NHs and Hispanics. These were the only two groups with enough cases to perform any meaningful analyses (a minimum of 5 cases/year). Since there were fewer than 5 cases among Hispanics in 2000, the trends were analyzed from 2001 to 2009. While the incidence rates increased for both white, NHs and Hispanics (APCs of 1.3% and 2.9%, respectively), neither trend was significant. (Figure 13)



Source: Massachusetts Cancer Registry.* Rates are age-adjusted to the US standard 2000 population for ages 0-19.

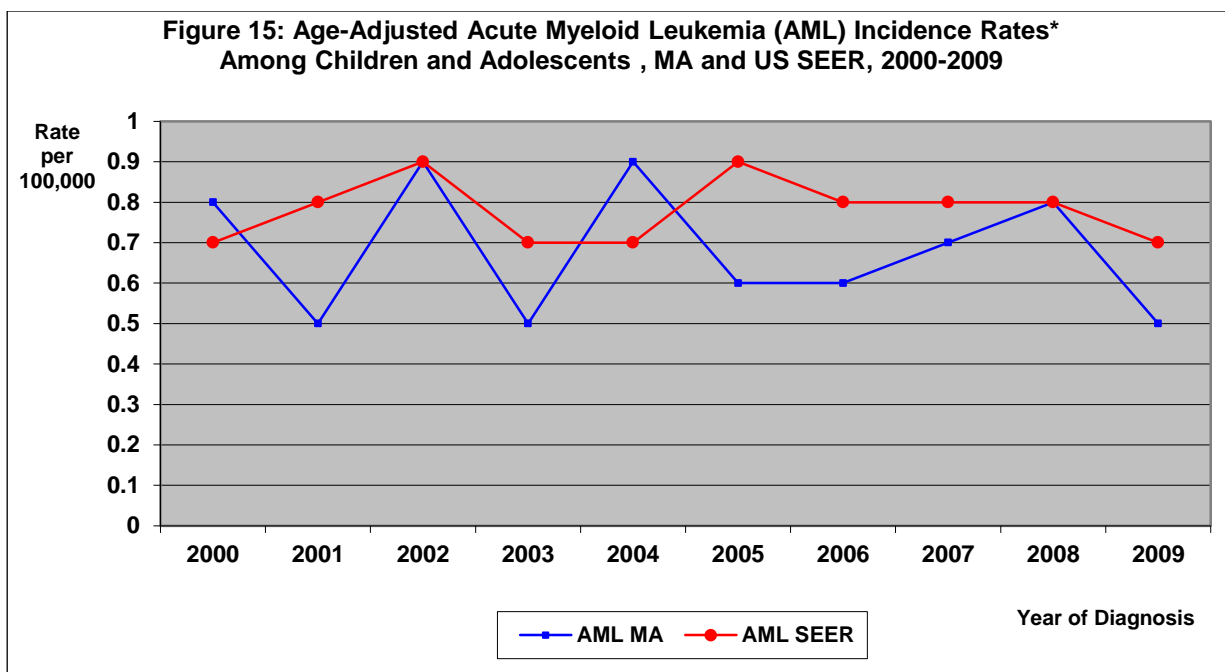
There are five subgroups of leukemia (acute lymphoid leukemia, acute myeloid leukemia, chronic myeloproliferative leukemia, myelodysplastic syndrome, and unspecified leukemia).

Acute lymphoid leukemia (ALL) is an acute (fast growing) leukemia that starts in the lymphoid cells of the bone marrow.⁵ Nationally, it accounted for 75.9% of all childhood and adolescent leukemias diagnosed from 2000-2009 while statewide it accounted for 77.7% (n=548) of leukemia cases. A significantly larger percentage of ALL cases were male compared to female (56.4% vs. 43.6%). ALL was more likely to be diagnosed in the younger age groups with 72.5% of cases diagnosed before the age of 10 and 51.3% before the age of 5. There were statistically significant increases in the incidence trends for ALL in both Massachusetts and the US (APC=3.2 and 1.2, respectively) (Figure 14).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Acute myeloid leukemia (AML) starts in myeloid cells that form white cells (other than lymphocytes), red blood cells, or platelets.⁵ It accounted for 18.3 % of US childhood and adolescent leukemia cases and 16.3% (n=115) of 2000-2009 Massachusetts cases of which 44.4% were male and 55.7% female, no significant difference. Of the Massachusetts cases, 29.6% were diagnosed before the age of five and 61.8% were diagnosed between 10 and 19 years. In Massachusetts, the incidence trend for AML decreased non-significantly with an APC of 1.2% while nationally the trend remained stable with an APC of 0% (Figure 15).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

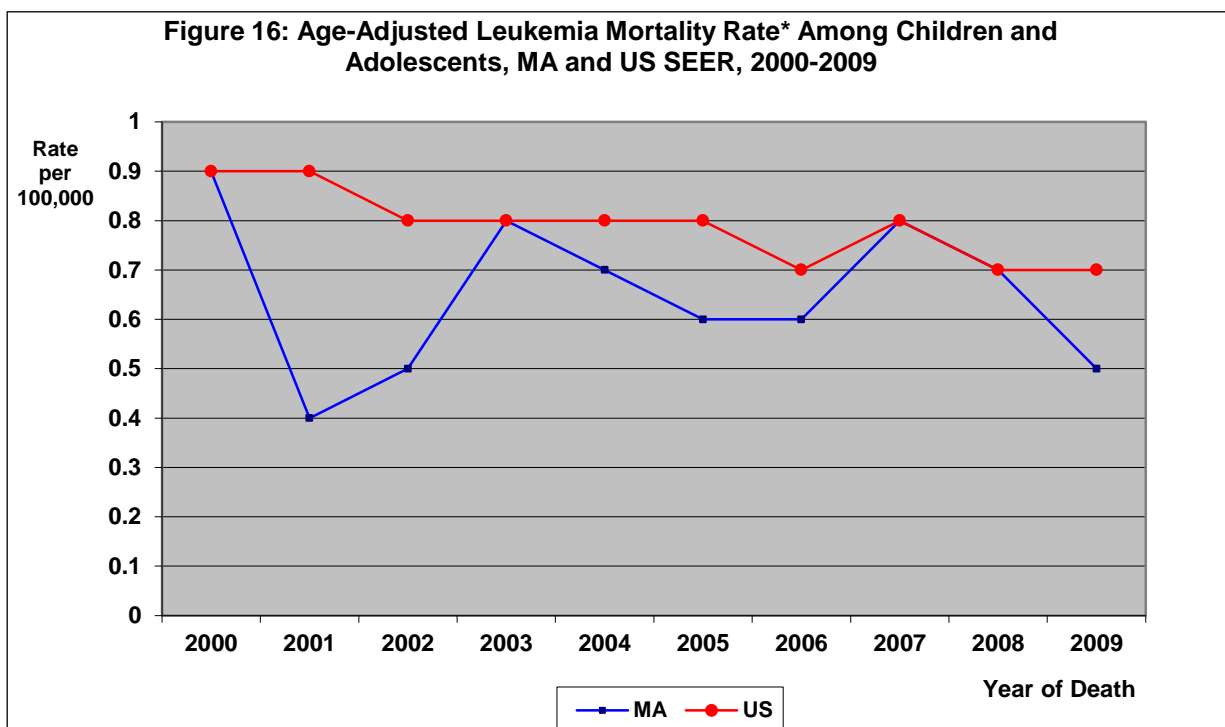
Chronic myeloproliferative leukemia (CML) is a chronic (slow growing) form of leukemia that occurs more often among older adults and is rare in children⁵. It accounted for 2.5% of US childhood and adolescent leukemia cases and 3.8% of Massachusetts cases (51.9% male and 48.2% female, no significant difference). Of the Massachusetts cases, 51.9% were diagnosed after the age of 14. Since there were only 27 cases diagnosed in Massachusetts over the ten year period, it was not possible to meaningfully compare racial/ethnic groups or examine time trends.

Myelodysplastic syndrome (MDS), also more frequent in adults and rare in children, is a bone marrow disorder sometimes referred to as ‘preleukemia’ due to its tendency to transform into acute myeloid leukemia.⁶ There were seven cases diagnosed over the ten year period, which was 1% of all Massachusetts childhood and adolescent leukemia cases similar to 0.8% of US SEER cases. Of the Massachusetts cases, 71.4% were diagnosed before the age of five.

Unspecified leukemias are cases reported without a type specified and accounted for 1.1% of Massachusetts leukemia cases (n=7) and 2.5% of US cases. Of these cases, 87.5% were diagnosed before the age of five.

Leukemia Mortality and Survival:

There were 107 leukemia-related deaths among Massachusetts children and adolescents from 2000 to 2009. The annual age-adjusted mortality rate for all leukemia cases aged 0-19 at the time of death was compared with US rates (Figure 16). The Massachusetts trend decreased non-significantly (-0.2% APC) while the US trend decreased significantly (-2.6% APC). The 20-year trend in Massachusetts from 1990 to 2009 (not pictured), however, indicated a significant decrease (-3.1% APC) in leukemia deaths among children and adolescents.



Source: Massachusetts Registry of Vital Records and Statistics and the National Center for Health Statistics.

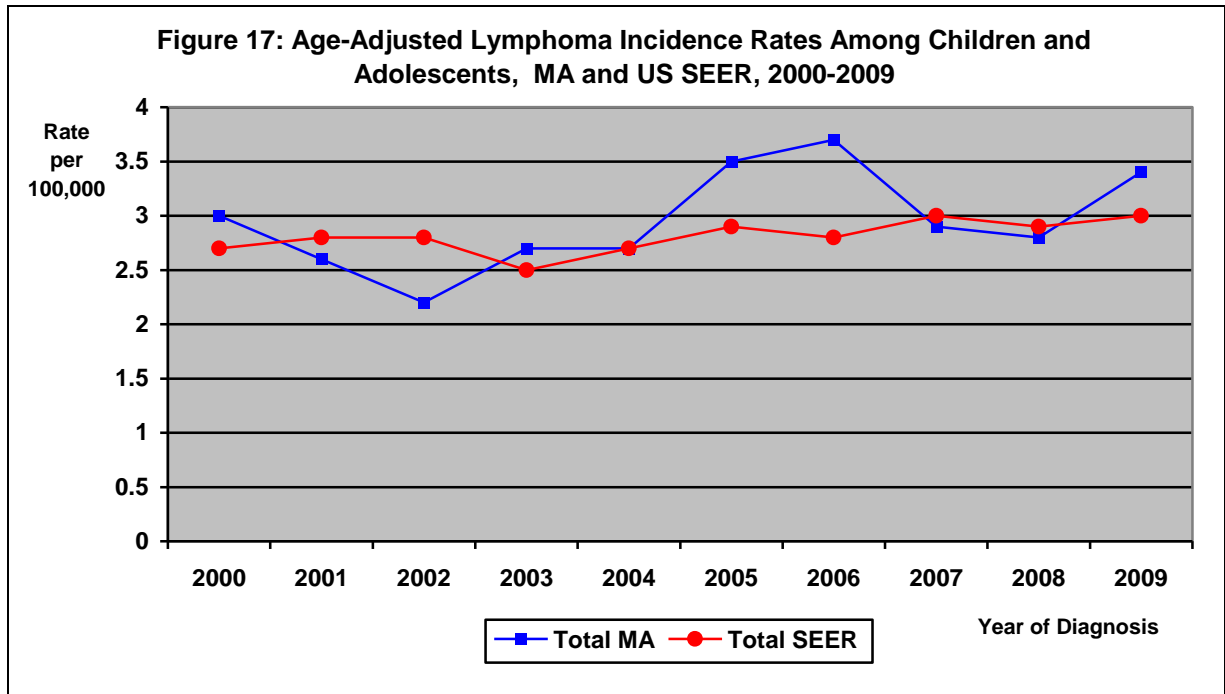
* Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Leukemia cases diagnosed from 2000 to 2004 were analyzed to determine the cumulative five year cause-specific survival in Massachusetts compared with US SEER survival.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Acute Myeloid Leukemia (n=55)	72.8%	61.0%
Acute Lymphoid Leukemia (n=246)	89.3%	86.0%

LYMPHOMAS

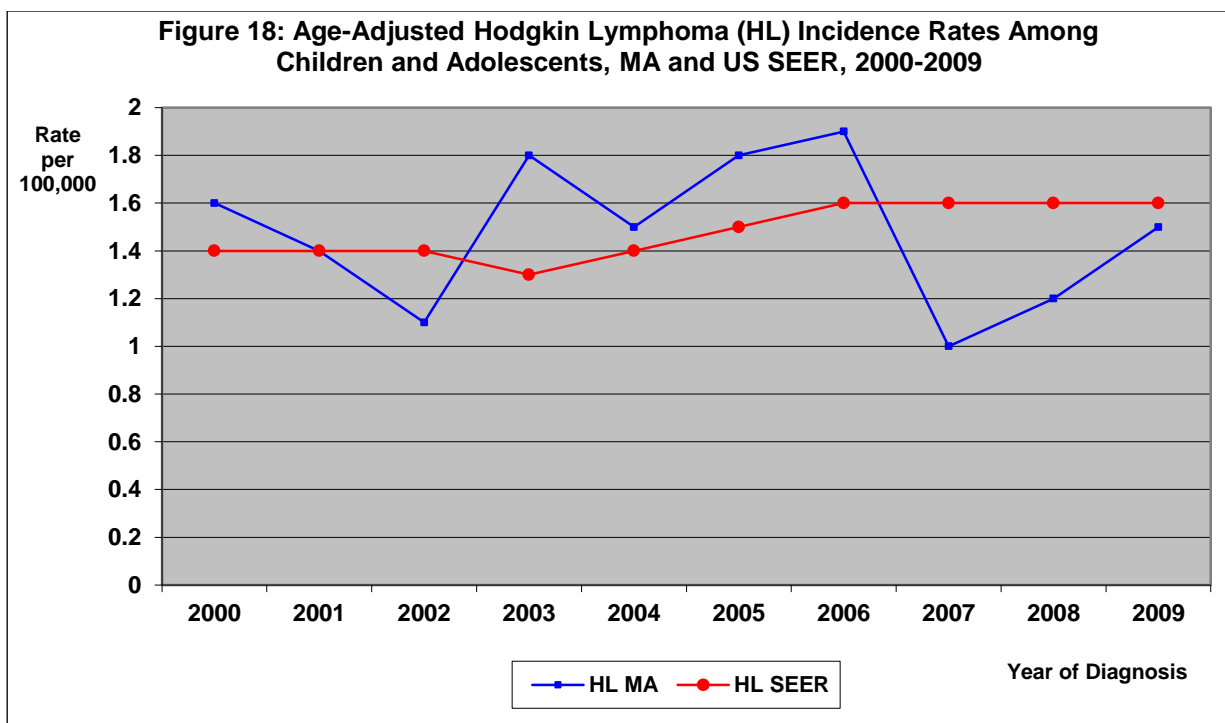
Lymphomas are cancers that develop in cells called lymphocytes, which are located in the lymph nodes and lymphoid tissues (such as the spleen and bone marrow) and are used in the fight against infections and disease.⁷ From 2000-2009, lymphoma accounted for 16.6% of MA childhood and adolescent cases (n=499) and 14.4% of US cases. Figure 17 compares incidence trends for all lymphomas from 2000 to 2009 in Massachusetts and the US. Neither the incidence trend in Massachusetts (APC= 2.6%) or in the US (US APC= 2.0%) was significant.



Source: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

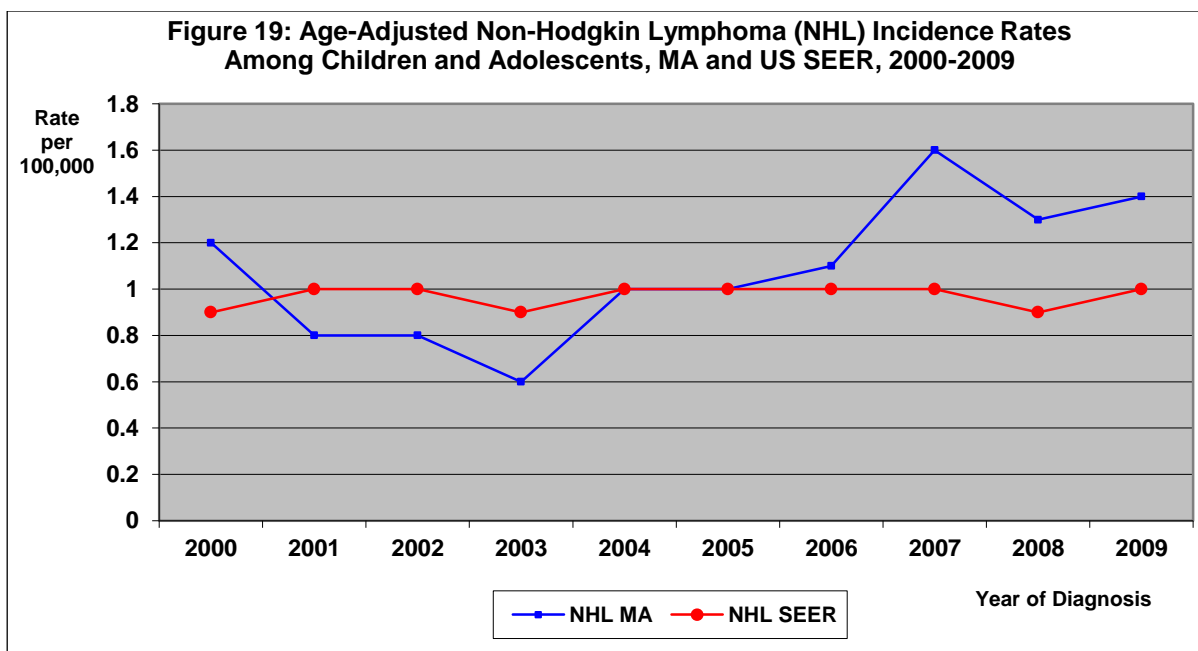
There are 5 subgroups of childhood lymphoma: Hodgkin lymphoma (HL), non-Hodgkin lymphoma (NHL), Burkitt lymphoma, miscellaneous lymphoreticular neoplasms, and unspecified lymphoma.

Hodgkin lymphoma (HL) is a type of lymphoma that involves the Reed-Sternberg cells. Those lymphomas that don't involve these cells are referred to as non-Hodgkin lymphoma.⁸ Among children and adolescents diagnosed with lymphoma from 2000 to 2009, 49.7% of US lymphoma cases fell into the HL category compared with 50.5% (n=252) of Massachusetts cases. Of the Massachusetts childhood and adolescent cases, 92.5% were diagnosed between the ages of 10 and 19, with 65.5% of those diagnosed from 15 to 19. Of the HL cases, 51.2% were male and 48.8% female, a non-significant difference. Figure 18 compares incidence trends for all HL cancer from 2000 to 2009 in Massachusetts and the US SEER Registries. While the incidence trend in Massachusetts was not significant (APC= -1.1%), the national trend was (APC= 2.0%).



Source: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Non-Hodgkin lymphoma, excluding Burkitt lymphoma (NHL) in children comprises three main types. Lymphoblastic and large cell lymphomas are categorized separately from Burkitt according to the ICCC-3 classifications.⁷ Of the US SEER childhood and adolescent lymphoma cases diagnosed from 2000 to 2009, 35.4% fell into this category compared with 36.5% (n=182) of Massachusetts cases. A significantly larger percentage of Massachusetts NHL cases were male compared to female (67.0% vs. 33.0%). Of the NHL cases, 77.5% were diagnosed after the age of 14. While the increasing incidence trend in Massachusetts was statistically significant (APC= 6.0%), the national trend was not (US APC= 0.1%) (Figure 19).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Burkitt lymphoma is a form of non-Hodgkin lymphoma that develops from B lymphocytes and is one of the fastest growing cancers known. A child will typically develop a large tumor in his/her abdomen that can sometimes block the intestines.⁷ While 10.1% of US childhood and adolescent lymphoma cases fell into this category, 11.0% of MA cases did (n=55). A significantly larger percentage of these cases were male compared to female (78.2% vs. 21.8%). Only 7.3% of the cases were diagnosed before the age of five and the remaining age groups had relatively equal percentages ranging from 29.1% to 32.7%.

Lymphoreticular neoplasm, not otherwise specified accounted for 1.4% of US lymphoma cases and 1.8% of MA lymphoma cases (n=9).

Lymphoma, not otherwise specified accounted for 1.3% of US lymphoma cases and less than 1% of MA cases (n<5).

Lymphoma Mortality and Survival:

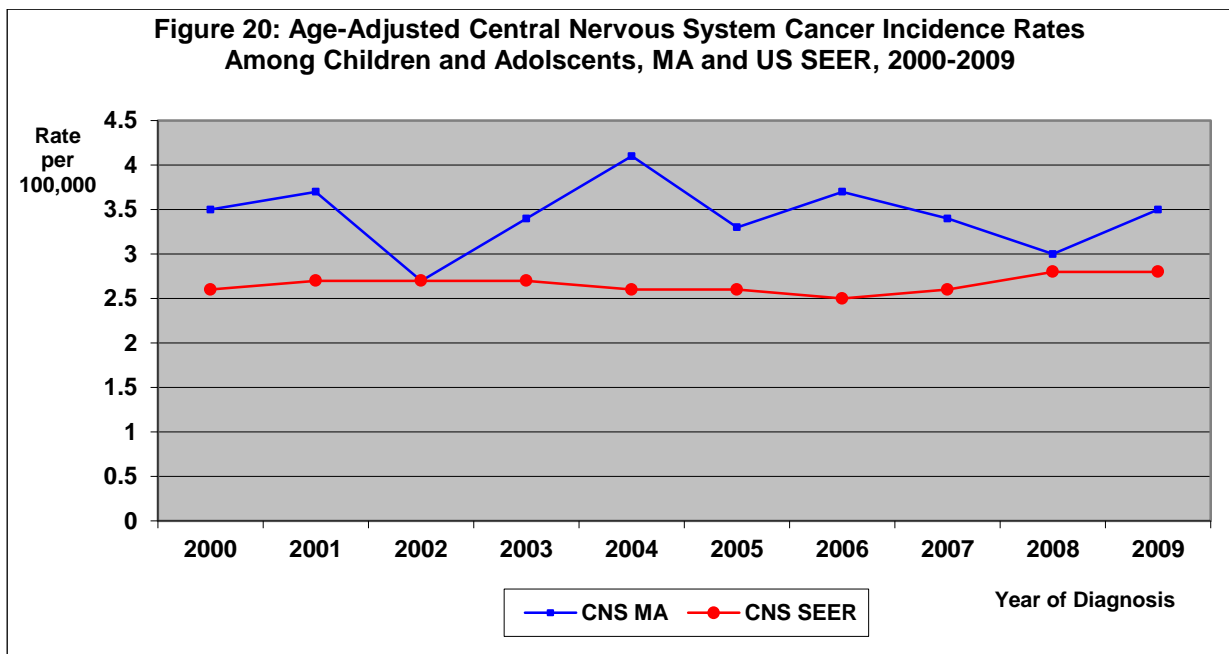
There were 17 lymphoma-related deaths among children and adolescents from 2000 to 2009. There were too few deaths to calculate age-specific mortality and the numbers were evenly distributed across the years.

Lymphoma cases diagnosed from 2000 to 2004 were analyzed to determine the five-year cause-specific cumulative survival compared to US SEER survival.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Hodgkin Lymphoma (n=122)	97.6%	95.2%
Non-Hodgkin Lymphoma (n=68)	82.2%	83.4%

CENTRAL NERVOUS SYSTEM

Central nervous system and miscellaneous intracranial and intraspinal neoplasms (CNS cancer) include tumors that arise from the brain, spinal cord, and other sites within the skull and spinal cord. From 2000-2009, CNS cancer accounted for 18.8% of Massachusetts childhood and adolescent cancer cases (n=563) and 17.4% of US cases. Figure 20 compares incidence trends for all CNS cancer from 2000 to 2009 in Massachusetts and the US. Neither trend was statistically significant (Massachusetts APC= -0.2% and US APC= 0.2%).

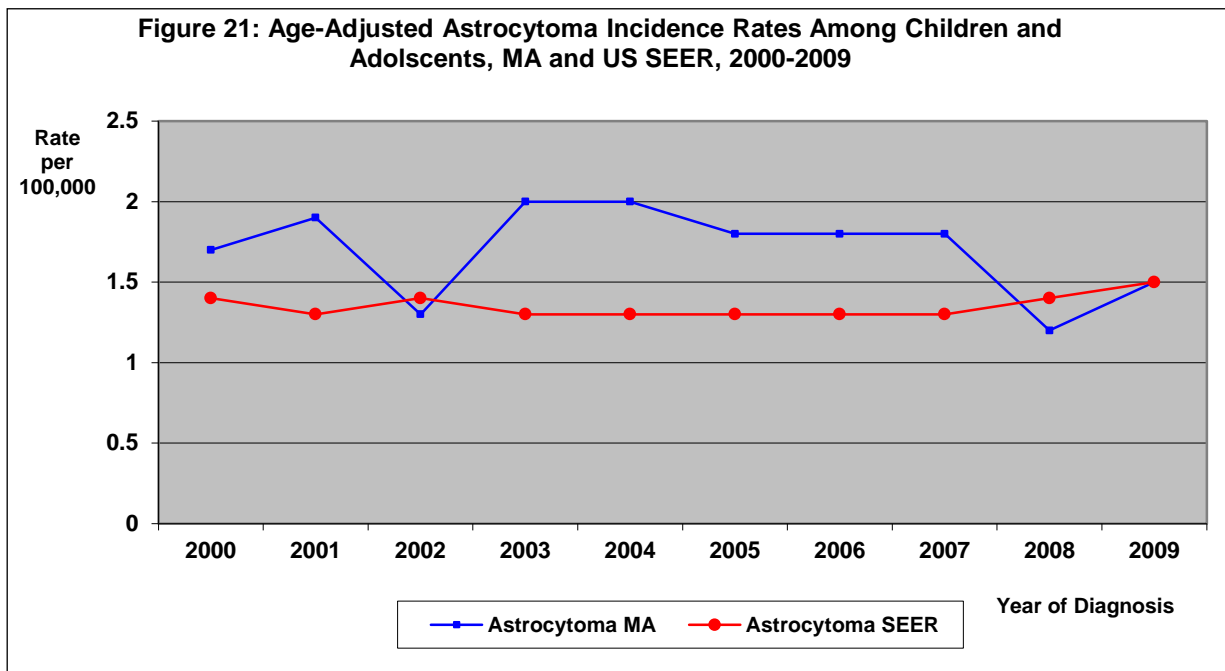


Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

There are 5 types of childhood brain and central nervous system cancers: ependymomas and choroid plexus tumors, astrocytomas, embryonal tumors, other gliomas, and other intracranial tumors.⁹

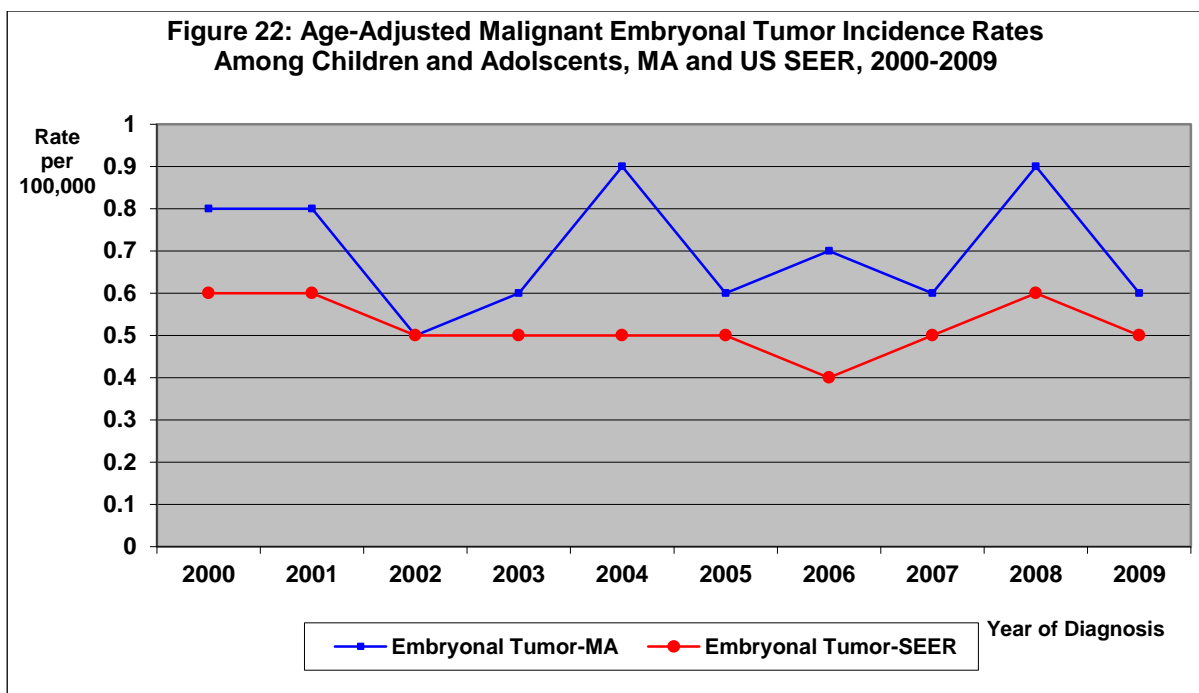
Ependymomas and choroid plexus tumors start in the ependymal cells that line the ventricles or central canal of the spinal cord. They may spread along the cerebrospinal fluid (CSF) but do not spread outside the brain or spinal cord. Unlike astrocytomas and oligodendrogliomas, they don't usually grow into brain tissue. Choroid plexus tumors are rare tumors that start in the choroid plexus within the ventricles of the brain.⁹ These tumors accounted for 9.1% of CNS childhood and adolescent cancers diagnosed in Massachusetts (n=51) and 8.7% diagnosed in the US. There was no significant difference in the percentage of these cases that were male compared to female (56.9% vs. 43.1%). The numbers were too small for any trend analysis.

Astrocytomas can spread widely throughout and mingle with normal brain tissue. There are three grades of astrocytomas: low grade – slow growing and the most common type in children, anaplastic – moderate growing, and glioblastoma – the highest grade and the fastest growing. Most of the tumors that develop within the brain begin in cells known as astrocytes, a type of glial cell.⁹ They accounted for 49.7% of CNS childhood and adolescent cancers diagnosed in Massachusetts (n=280) and 49.0% diagnosed in the US. There was no significant difference in the percentage of astrocytoma cases that were male compared to female (53.6% vs. 46.4%) and no strongly predominant age group. Figure 21 compares incidence trends for malignant astrocytomas from 2000 to 2009 in Massachusetts and the US. Neither trend was significant (Massachusetts APC= -1.9% and US APC= 0.3%).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Embryonal tumors begin in embryonic (fetal) cells in the brain and spinal cord. There are six types of embryonal tumors: medulloblastoma, pineal gland tumors, CNS primitive neuroectodermal tumors, medulloepithelioma, and ependymoblastoma.⁹ They accounted for 19.7% of CNS childhood and adolescent cancers diagnosed in Massachusetts (n=111) and 21.8% diagnosed in the US. There was no significant difference in the percentage of embryonal tumor cases that were male compared to female (51.4% vs. 48.7%) and 39.6% of the cases were diagnosed before the age of 5 compared to 31.5% from age 10-19. Figure 22 compares incidence trends for malignant embryonal tumors from 2000 to 2009 in Massachusetts and the US. Neither trend was significant (Massachusetts APC= -0.5% and US APC= -0.8%).



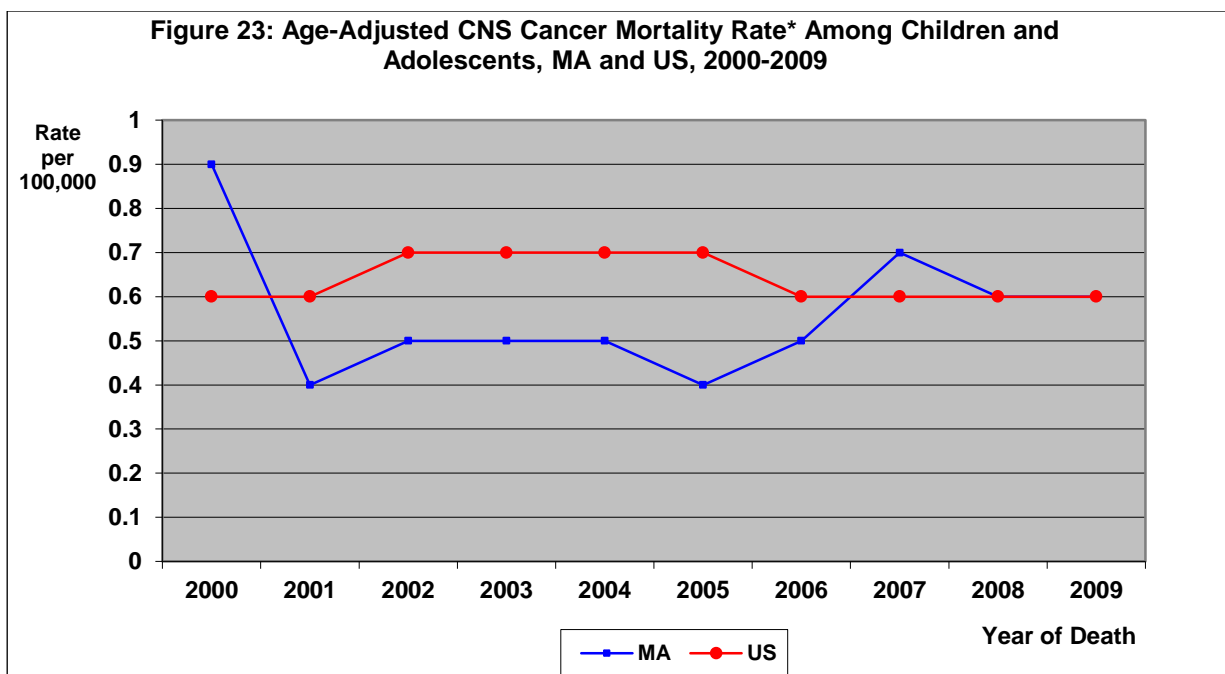
Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Other gliomas, representing other types of malignant gliomas, accounted for 16.7% of Massachusetts CNS childhood and adolescent cancers (n=94) and 17.6% of US CNS cancers diagnosed among 0-19 year olds from 2000-2009. There was no significant difference in percentage of diagnoses between males and female cases (58.5% vs. 41.5%). There also was no predominant age group diagnosed with this cancer.

Other intracranial tumors, representing CNS cancers not otherwise categorized, accounted for 4.3% of CNS cancers in Massachusetts (n=24) and 2.9% in the US.

CNS Mortality and Survival:

In Massachusetts, there were 91 CNS-related deaths among children and adolescents from 2000 to 2009. The annual age-adjusted mortality rate for all CNS cases aged 0-19 at the time of death in Massachusetts and the US were compared from 2000-2009 (Figure 23). In the US, the deaths decreased with an APC of -1.6%, which was not statistically significant. The Massachusetts APC increase of 0.4% also was not significant.



Source: Massachusetts Registry of Vital Records and Statistics and the National Center for Health Statistics.

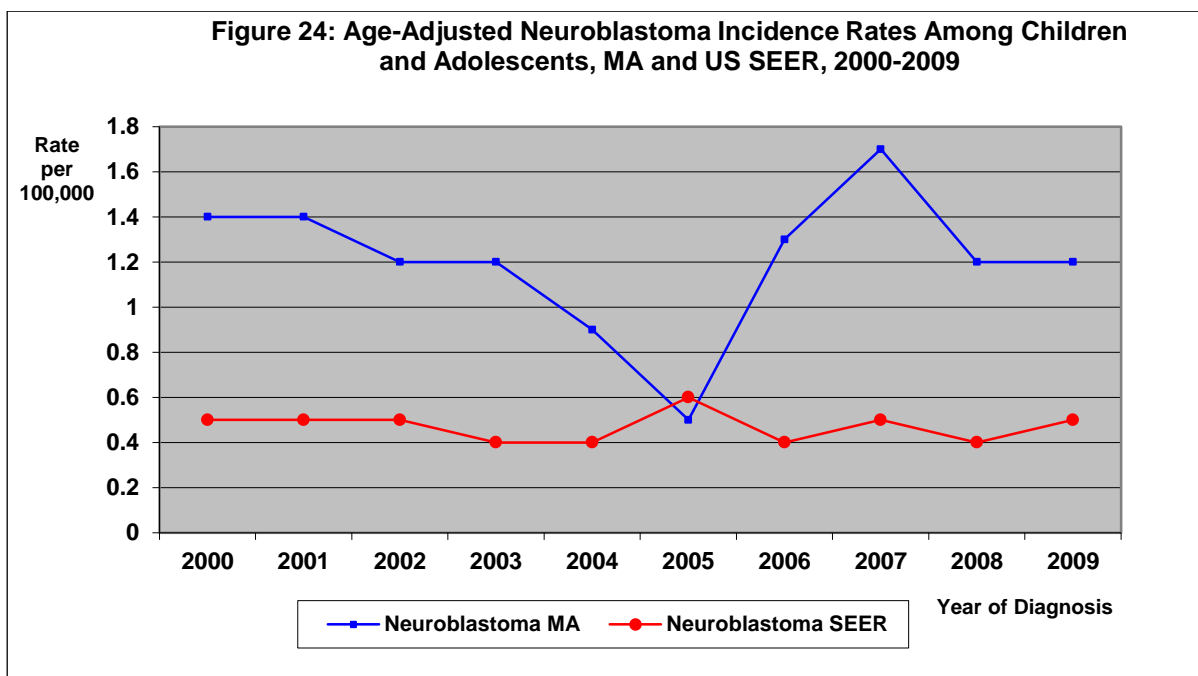
* Rates are age-adjusted to the US standard 2000 population for ages 0-19.

CNS cases diagnosed from 2000 to 2004 were analyzed to determine the five-year cause-specific cumulative survival compared to US SEER survival.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Ependymomas (n=27)	81.4%	72.2%
Astrocytomas (n=146)	90.3%	84.0%
Embryonal Tumors (n=58)	74.0%	64.5%
Other Gliomas (n=38)	55.2%	58.1%

TUMORS OF PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system (PNS) consists of the sensory neurons (which send stimulus signals to the central nervous system (CNS)) and motor neurons (which send out action signals from the CNS). The peripheral nervous system is divided into the sensory-somatic nervous system (which controls scent, sight, hearing, taste, facial muscles, swallowing, etc.) and the autonomic nervous system (which controls the heart, lungs, exocrine glands, endocrine glands, and other internal organs, in particular the intestines in an involuntarily manner).¹⁰ The two types of peripheral nervous system cancers in children are neuroblastomas and other peripheral nervous system cancers. Since 98.8% of the cases were neuroblastomas, this section will focus on that cancer. From 2000-2009, neuroblastomas accounted for 6.4% of Massachusetts cases (n=193) and 4.5% of US SEER cases (and 98.0% of all US SEER PNS cancers). Figure 24 shows age-adjusted incidence trends for neuroblastoma from 2000 to 2009 for Massachusetts and the US, neither of which was statistically significant (Massachusetts APC= -0.7% and US APC=0.1%). The large drop and rise in the Massachusetts trend line is a reflection of the small number of annual cases (see Appendix III). There was no significant difference in the percentage of neuroblastoma cases that were male compared to female (54.9% vs. 45.1%) and 81.9% of these cases were diagnosed before the age of 5.



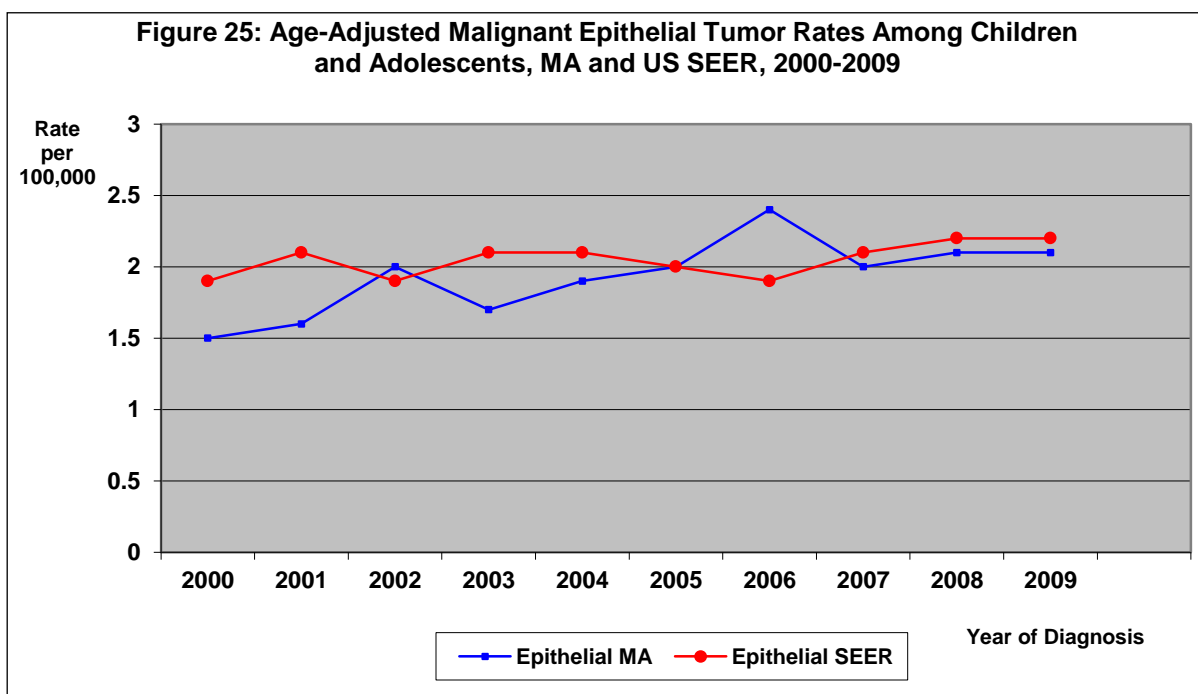
Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Peripheral Nervous System Mortality and Survival:

There were 25 PNS-related deaths among children and adolescents from 2000 to 2009. Of the Massachusetts cases diagnosed from 2000 to 2004 diagnosed with neuroblastoma, 75.0% survived at least 5 years post diagnosis compared with 74.6% of US SEER cases. Over 90% of the Massachusetts deaths listed adrenal gland cancer as the underlying cause of death.

MALIGNANT EPITHELIAL TUMORS

Carcinomas are cancers that develop from epithelial cells that form in the lining of organs; these represent many different types of cancer, including organs of the respiratory passageways, most organs of the digestive system, kidney tubules, walls of blood vessels, ovaries, urinary tract, and others.¹¹ Of the epithelial carcinomas, 96.6% were diagnosed after the age of 14. From 2000-2009, these cancers accounted for 11.1% of Massachusetts cases (n=333) and 9.9% of US SEER cases. Figure 25 compares age-adjusted incidence trends from 2000 to 2009 for Massachusetts (APC=3.7%, a statistically significant increase) and the US (APC=1.0%, a non-significant increase).



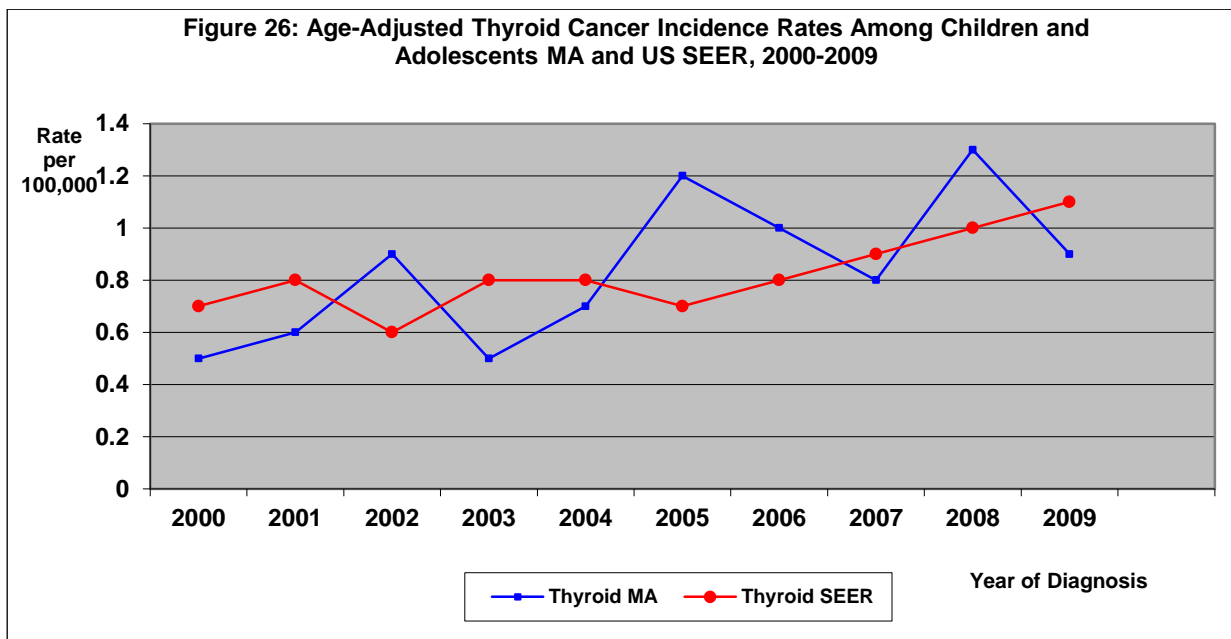
Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

There are six types of epithelial tumors usually seen among children and adolescents: adenocortical carcinomas, thyroid cancer, nasopharyngeal carcinoma, melanoma, other skin cancer, and other/unspecified carcinoma.

Adrenocortical carcinoma is a very rare pediatric tumor that arises from the adrenal gland. This cancer represented 1.2% of malignant epithelial tumors diagnosed in the US and less than 0.5% diagnosed in Massachusetts from 2000-2009 (n < 5).

Thyroid cancer is a carcinoma that develops in the thyroid gland. There were 146 cases diagnosed from 2000-2009, representing 43.8% of Massachusetts epithelial tumors, compared with 36.9% of US cases. The incidence rates increased significantly in Massachusetts (APC=8.0%) and significantly in the US (APC=4.5%) (Figure 26). This increase is mirrored in the adult population as well, with significant increases in incidence for both males and female in Massachusetts and the US.¹² Significantly more thyroid cases were female compared to

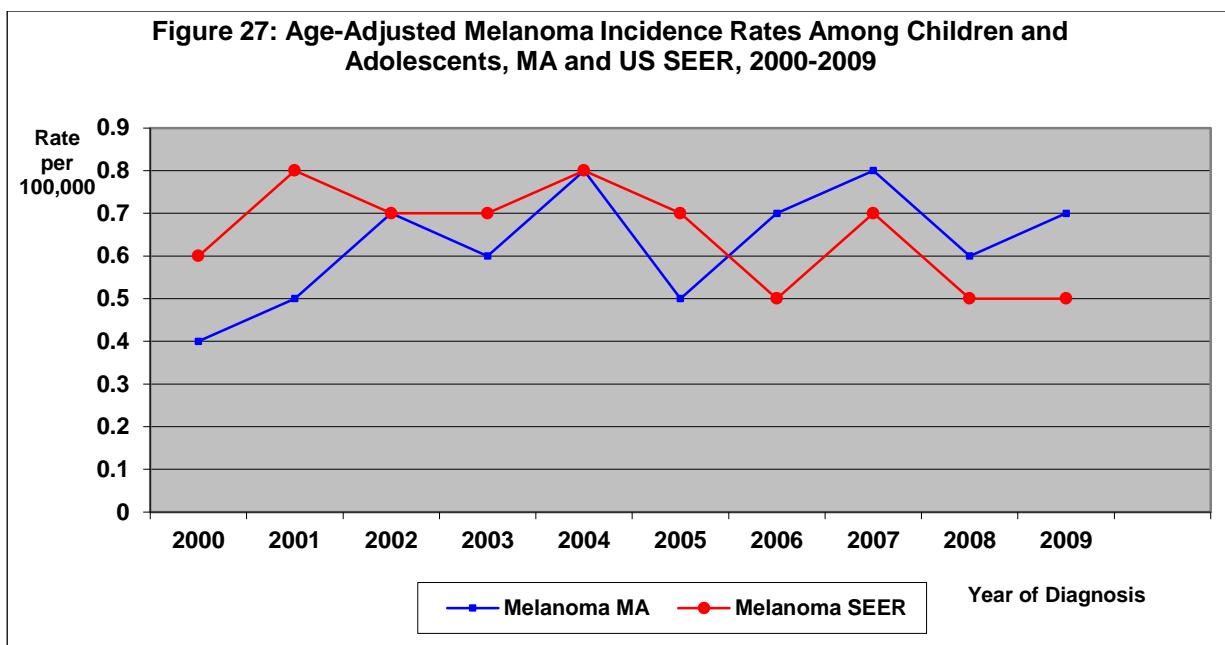
male (76.7% vs. 23.3%). The majority of thyroid cases occurred in the 15-19 age-group (80.8%) followed by the 10-14 age-group (16.4%).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Nasopharyngeal carcinoma is a carcinoma that affects the nose and pharynx and is also extremely rare, representing 3.0% of US childhood and adolescent epithelial tumor cases and 2.4% of MA cases (n=8).

Melanoma is a carcinoma that almost always develops in the skin, with rare cases developing in the eye or mouth. It is caused by changes in cells called melanocytes, which produce a skin pigment called melanin.¹³ There were 107 cases reported from 2000-2009, representing 32.1% of Massachusetts epithelial tumors, compared with 33.1% of US cases. The incidence rates increased non-significantly in Massachusetts (APC=4.3%) and decreased significantly in the US (APC=-3.7%) (Figure 27). The majority of melanoma cases occurred in the 15-19 age-group (77.6%) and the 10-14 age-group (17.8%). There was no significant difference in the percentage of male and female cases (42.1% vs. 57.9%).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Skin carcinoma is a carcinoma of the skin that is not histologically a melanoma nor basal or squamous cell carcinomas. These cases represented less than 1% of US epithelial carcinomas and MA carcinomas among children and adolescents ($n < 5$).

Other/unspecified carcinomas are carcinomas from other sites or an unknown site. They accounted for 22.7% of US and 20.7% of MA epithelial tumors ($n=69$).

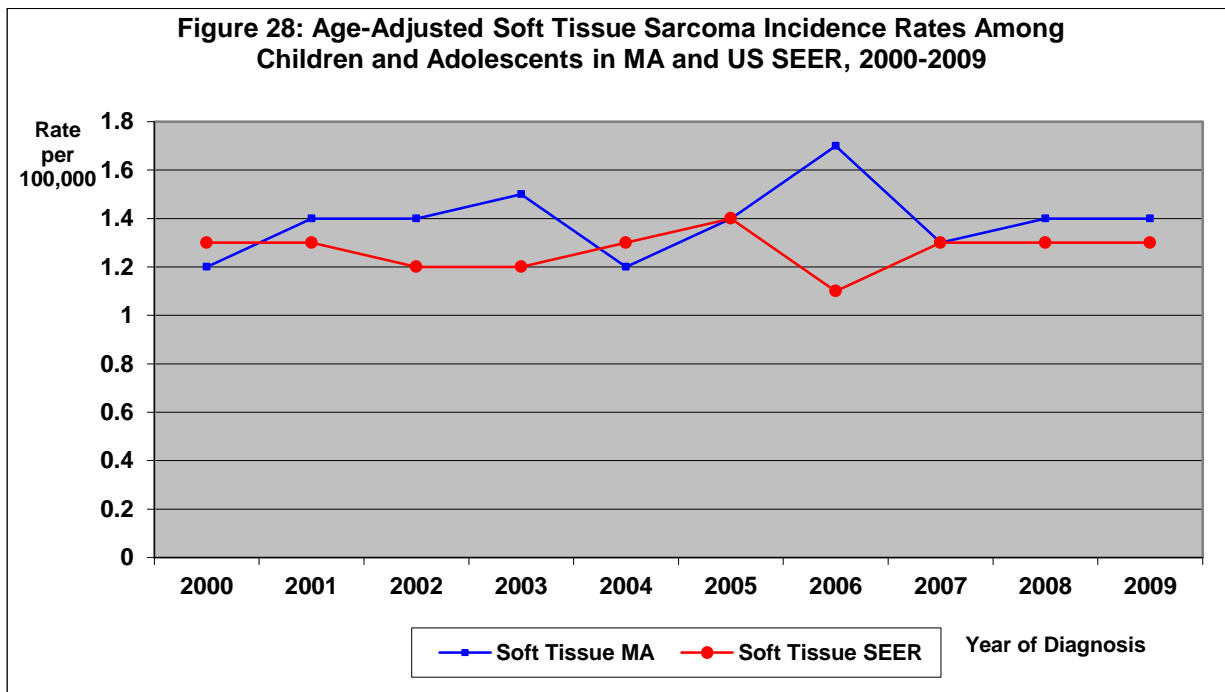
Malignant Epithelial Tumor Mortality and Survival:

There were fewer than 5 melanoma deaths and no thyroid cancer deaths among Massachusetts children and adolescents from 2000 to 2009. In addition to these, there were a total of 12 deaths related to the oral cavity, digestive tract, or respiratory tract organs. As a result of the small incidence numbers for the other epithelial cancers from 2000 to 2004, only melanoma and thyroid cancer cause-specific survival analyses were done for Massachusetts cases.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Thyroid Cancer (n=53)	100%	99.4%
Melanoma (n=49)	93.8%	96.3%

SOFT TISSUE SARCOMAS

Soft tissue sarcomas are cancers that develop in the supporting tissues such as muscle, fat, and blood vessels. From 2000-2009, this cancer accounted for 7.1% of MA childhood and adolescent cancer cases (n=212) and 7.3% of US cases. During this period, the incidence rate increased non-significantly in Massachusetts (APC= 0.9%) and in the US SEER Registries (APC=0.4%) (Figure 28).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

There are 4 types of soft tissue sarcomas in children and adolescents. There were too few cases of any of these subtypes to do any trend analysis.

Rhabdomyosarcoma is an aggressive soft tissue tumor that can arise anywhere in the body.¹⁴ There were 73 cases diagnosed from 2000-2009. Rhabdomyosarcoma was most commonly diagnosed in the youngest and oldest age groups, with 42.5% of the cases diagnosed before the age of five and 24.7% diagnosed between 15 and 19 years. A significantly larger number of these cases were male compared to female (61.6% vs. 38.4%). This subtype accounted for 34.4% of soft tissue cancers diagnosed among children and adolescents in Massachusetts compared with 39.2% diagnosed in the US SEER Registries.

Fibrosarcoma is a malignant tumor that originates in the connective tissue found at the ends of bones of the arms or legs and spreads to other surrounding tissue. There are two types of this cancer – infantile, which affects children under the age of one and adult, which can occur in older children and adolescents.¹⁵ There were 21 cases diagnosed from 2000-2009, accounting for 9.9% of Massachusetts childhood and adolescent soft issue sarcomas. In the US SEER Registries, fibrosarcoma cases accounted for 11.3% of soft tissue sarcomas. Fibrosarcoma was

most commonly diagnosed in the 15-19 age group, accounting for 61.9% of all child and adolescent fibrosarcoma cases.

Kaposi's sarcoma (KS) is a cancer that develops from the cells that line lymph or blood vessels. The abnormal cells of KS form purple, red, or brown blotches or tumors on the skin.¹⁶ This cancer represented less than 1% of US SEER and Massachusetts soft tissue cases (n <5).

Other soft tissue sarcomas includes sarcomas arising from other or unknown sites and accounted for 55.2% of soft tissue cancers diagnosed in Massachusetts (n=117) and 40.5% diagnosed in the US from 2000-2009. They were most commonly diagnosed in the older age groups, with 18.0%, 20.5%, and 53.0% reported in the 5-9, 10-14, and 15-19 age groups, respectively.

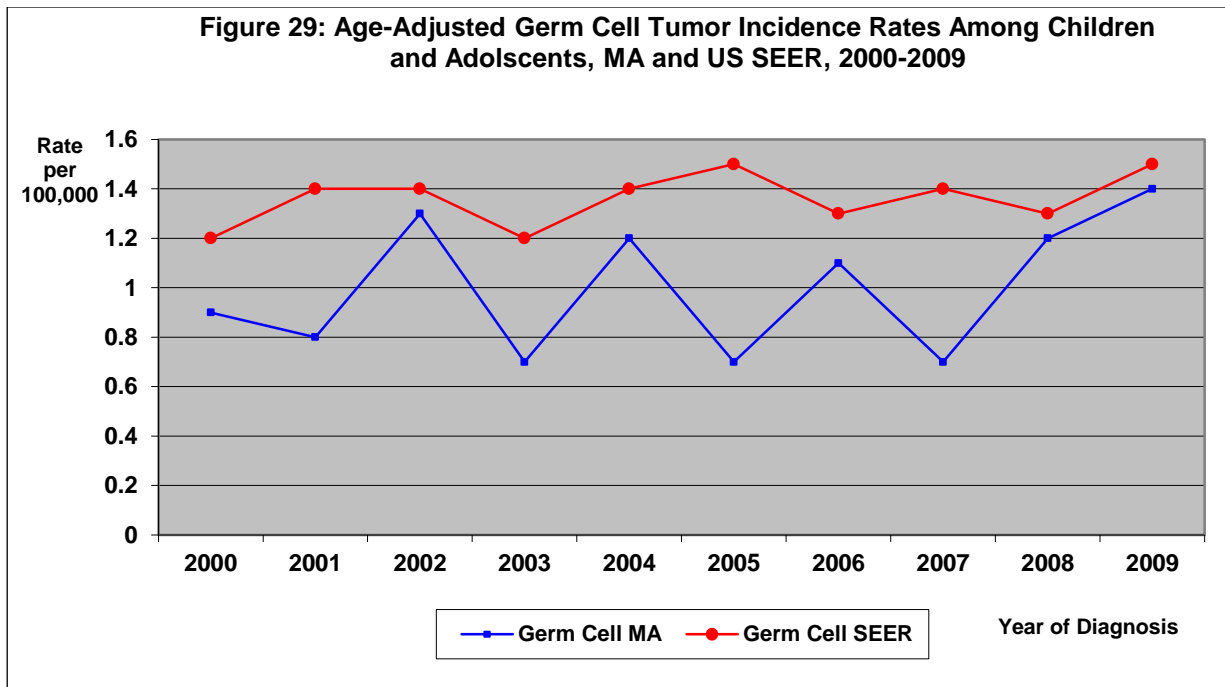
Soft Tissue Sarcoma Mortality:

In Massachusetts, there were 30 soft tissue sarcoma deaths from 2000-2009. The five year cause-specific cumulative survival percentages for rhabdomyosarcoma and other soft tissue sarcomas diagnosed from 2000 to 2004 were compared with US SEER survival percentages.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Rhabdomyosarcoma (n=35)	68.4%	63.0%
Other Soft Tissue Sarcoma (n=63)	88.8%	78.9%

GERM CELL TUMORS

Germ cell (egg or sperm), trophoblastic (cells outside an early embryo), and other gonadal (ovarian or testicular) neoplasms arise from the body's reproductive cells.⁴ Among children and adolescents in Massachusetts, 66.2% of germ cell tumors were diagnosed after the age of 14. From 2000-2009, this cancer accounted for 5.8% of Massachusetts childhood and adolescent cancer cases (n=174) and 6.9% of US cases. Figure 29 compares age-adjusted incidence trends from 2000 to 2009 for Massachusetts (APC=2.8%, non-significant) and the US (APC=0.7%, non-significant).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19

There are five types of germ cell tumors in children and adolescents. There were too few cases a year to perform any trend analysis.

Intracranial germ tumor – These are tumors of the brain that develop when the sex cells normally found in the ovaries and testes do not migrate down and become trapped in the brain. They are most frequently found around the pituitary and pineal glands.¹⁶ They accounted for 12.6% of germ cell tumors diagnosed in Massachusetts from 2000-2009 (n=22) and 15.9% diagnosed in the US.

Extracranial/Gonadal germ cell – These are germ cell tumors located in neither the brain or the testes or ovaries.¹⁵ They accounted for 13.2% of germ cell tumors diagnosed in Massachusetts from 2000-2009 (n=23) and 14.1% diagnosed in the US.

Gonadal germ cell – These are germ cells located in either the testes or ovaries.¹⁵ They accounted for 64.4% of germ cell tumors diagnosed in Massachusetts from 2000-2009 (n=112)

and 65.0% of those diagnosed in the US. In Massachusetts, a significantly larger number of these cases were male compared to female (75.0% vs. 25.0%).

Gonadal carcinomas accounted for 5.2% of Massachusetts germ cell tumor cases (n=9) and 3.4% of US cases.

Other gonadal tumors accounted for 4.6% of germ cell tumor cases (n=8) and 1.6% of US cases.

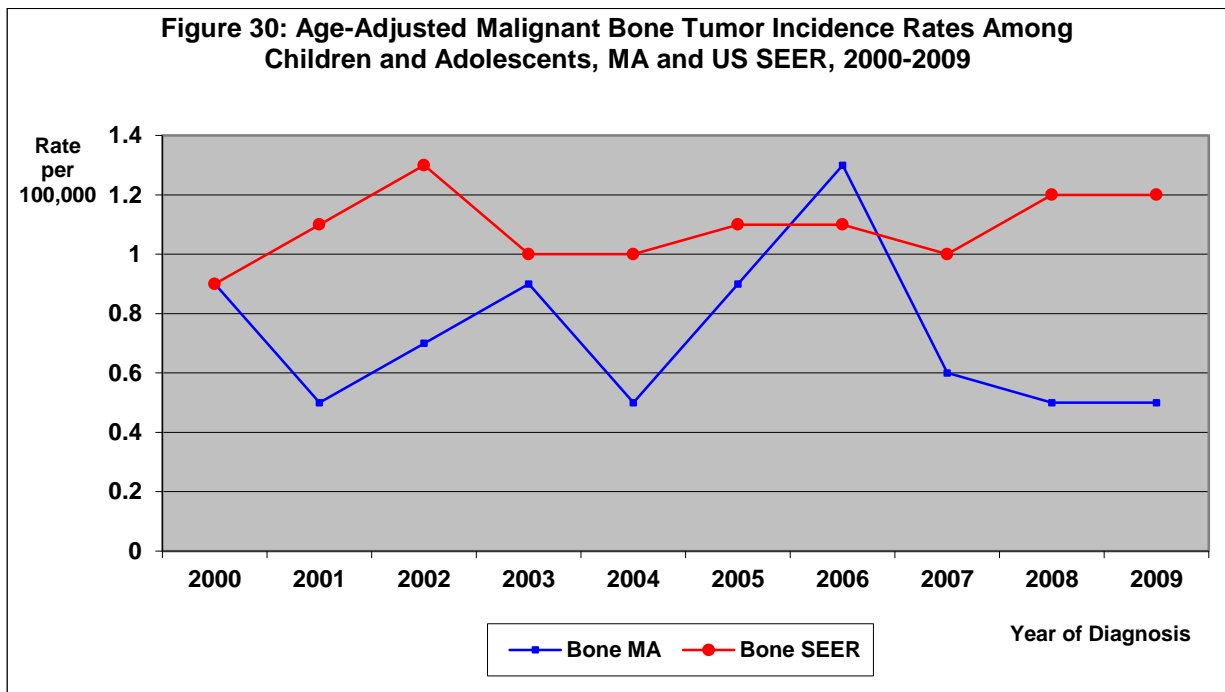
Germ Cell Tumor Mortality and Survival:

Since there were fewer than 10 cases of extracranial/gonadal germ cell tumors diagnosed from 2000 to 2004, cause-specific survival related analyses were performed for only gonadal germ cell tumors in Massachusetts.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Gonadal Germ Cell Tumor (n=55)	98.2%	78.9%

MALIGNANT BONE TUMORS

Cancers that originate in the bones are known as primary bone cancers. They occur most often in older children and adolescents but can develop at any age.¹⁹ From 2000-2009, this cancer accounted for 4.1% of Massachusetts childhood and adolescent cancer cases (n=124) and 5.3% of US SEER cases. Figure 30 compares age-adjusted incidence trends from 2000 to 2009 for Massachusetts (APC=-2.6%, non-significant) and the US (APC=1.2%, non-significant).



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

There are four types of bone cancers seen among children and adolescents. There were too few cases to perform any trend analysis on the specific types.

Osteosarcoma is the most common type of bone cancer that develops in areas where the bone is growing quickly, such as near the ends of long bones. Although osteosarcoma can develop in any bone, the most common sites are the bones around the knee and the shoulder.²⁰ It accounted for 58.1% of childhood and adolescent bone cancers diagnosed in Massachusetts from 2000-2009 (n=72) and 58.4% of US SEER cases. Osteosarcoma was most commonly diagnosed in the 10-14 (44.4% of cases) and the 15-19 (37.5%) age-groups. There was no significant difference between male and female osteosarcoma cases (55.6% vs. 44.4%).

Chondrosarcoma is a rare bone tumor that accounted for 4.0% of US SEER childhood and adolescent bone cancers and 1.6% of 2000-2009 Massachusetts bone cancers (n < 5).

Ewing sarcoma is another type of bone cancer different from osteosarcomas at the microscopic tissue level.²¹ It accounted for 36.3% of childhood and adolescent bone cancers diagnosed in Massachusetts from 2000-2009 (n=45) and 30.8% of US SEER cases. As with osteosarcoma, the 10-14 and 15-19 age groups accounted for the majority of the cases, 44.4%

and 31.1%, respectively. There was no significant difference between males and females diagnosed (62.2% vs. 37.8%).

Other bone cancers accounted for 4.0% of malignant bone tumors diagnosed in Massachusetts from 2000-2009 (n=5) and 4.8% diagnosed in the US SEER Registries.

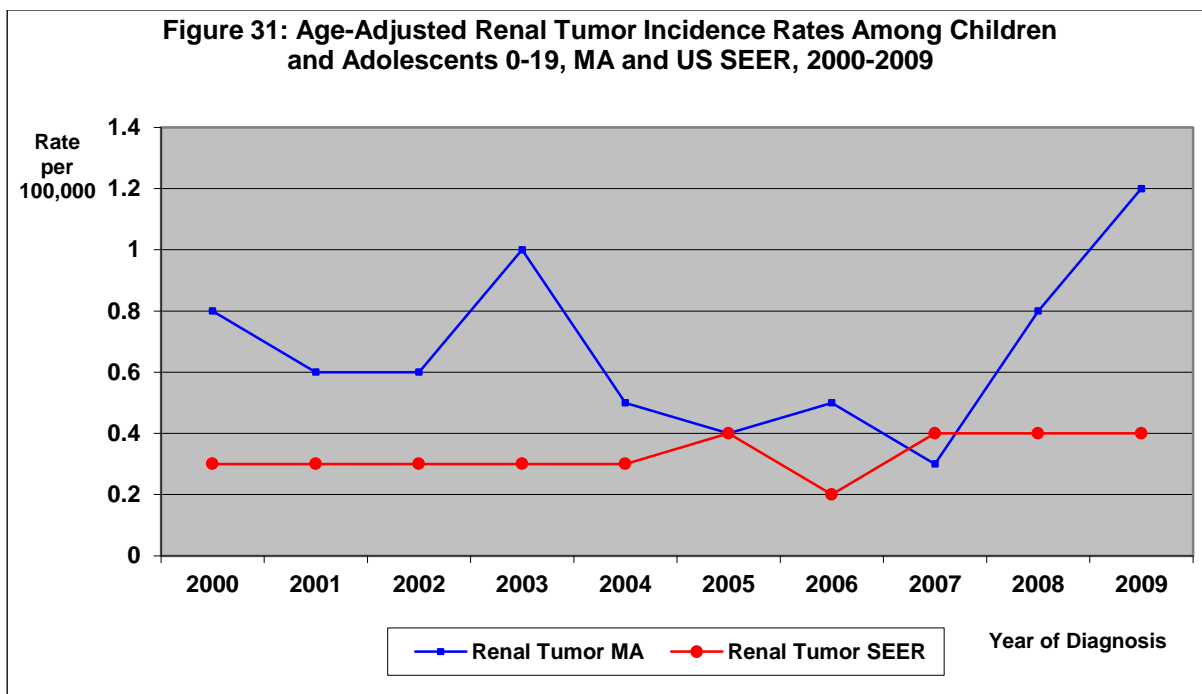
Malignant Bone Tumor Mortality:

The five-year cumulative cause-specific survival for osteosarcoma cases diagnosed from 2000 to 2004 were compared for Massachusetts and the US.

Childhood Cancer	MA 5-Year Survival	US SEER 5-Year Survival
Osteosarcoma (n=33)	63.5%	68.3%

RENAL TUMORS

Renal tumors are those cancers that originate in the kidney. There were 109 renal tumors diagnosed among children and adolescents from 2000 to 2009, representing 3.6% of all childhood and adolescent cancers in Massachusetts compared with 3.8% for the US SEER Registries. Wilms' tumor is the most common type of renal tumor among children and adolescents, accounting for 89.0% of renal tumor cases diagnosed from 2000-2009 (n=97). The majority of Wilms' tumor cases were diagnosed either before the age of five (66.0%) or from five to nine years (27.8%). There was no significant difference between male and female renal tumor cases diagnosed from 2000-2009 (48.6% vs. 51.4%). The other types of renal tumors, renal carcinoma and other nephroblastoma accounted for the remaining 11%. Figure 31 compares age-adjusted incidence trends from 2000 to 2009 for MA (APC=-0.1%, non-significant) and the US (APC=1.4%, non-significant). The numbers were too small to do further analysis.



Sources: Massachusetts Cancer Registry and SEER 18 Registries. * Rates are age-adjusted to the US standard 2000 population for ages 0-19.

Malignant Renal Tumor Mortality and Survival:

There were 5 malignant renal tumor deaths in Massachusetts from 2000 to 2009. Of the 53 Massachusetts cases diagnosed from 2000 to 2004, 92.2% survived at least five years after diagnosis compared to 89.7% of US SEER cases. While there were no available SEER data for Wilms' tumor, 94.1% of the 51 Massachusetts cases diagnosed from 2000 to 2004 survived at least five years.

RETINOBLASTOMA

Retinoblastoma is a cancer of the eye that occurs among very young children. About 40% of cases of retinoblastoma are due to inherited mutations (changes) in a retinoblastoma-related gene. The remaining 60% of cases of retinoblastoma result from sporadic (random) mutations in a gene.¹⁷ There are no subtypes of retinoblastoma. There were 42 cases diagnosed from 2000-2009, representing 1.4% of all cancers in children and adolescents compared to 1.9% for the US SEER Registries. Nearly 100% of these cases were diagnosed before the age of five. There was no significant difference between males and females diagnosed from 2000-2009 (40.5% vs. 59.5%).

Retinoblastoma Mortality and Survival:

There were fewer than 5 deaths from 2000 to 2009 due to retinoblastoma. There were too few incident cases in Massachusetts to do any trend or survival analysis. Of US SEER cases, 98.0% survived at least five years.

HEPATIC (LIVER) TUMORS

Malignant hepatic tumors are cancers that originate in the liver. The two types of malignant hepatic tumors in children and adolescents are hepatoblastomas and hepatic carcinomas.¹⁷ There were 33 hepatic tumors diagnosed from 2000 to 2009, representing 1.1% of all cancers in children and adolescents compared with 1.3% for the US SEER Registries. Hepatoblastomas accounted for 84.6% of those Massachusetts cases (n=28). Of all hepatic tumors, 78.9% and 92.9% of hepatoblastomas were diagnosed before the age of 5. There was no significant difference between males and females diagnosed with hepatic tumors (60.7% vs. 39.3%).

Hepatic Tumor Mortality and Survival:

From 2000-2009, there were 7 deaths from liver cancer. There were too few incident cases in Massachusetts to do any trend or survival analysis. Of US SEER cases, 62.8% survived at least five years.

DISCUSSION

From 2000 to 2009, 3001 cases of invasive cancer were diagnosed among children and adolescent residents of Massachusetts. In the same period, 359,058 cancer cases were diagnosed among the entire Massachusetts population. While the overall cancer burden among children and adolescents (0.8% of all cancers) was disproportionately much lower compared to their proportion in the total population (25.3% of the Massachusetts population), specific cancers disproportionately affected the 0-19 years age-group compared to cancers in all groups.

- 8.4% of all leukemia cases, 11.5% of all Hodgkin lymphoma cases, and 11.3% of all CNS cases occurred among children and adolescents, a much larger representation than children's and adolescents' proportion of all Massachusetts cancer cases (0.8%).
- Among all Massachusetts cancer cases, 2.7% of male and 2.4% of female cases were leukemia. In contrast, 23.6% of childhood and adolescent male cancer cases and 23.3% of childhood and adolescent female cases were leukemia. Leukemia rates were highest among children aged 0-4.
- Among all Massachusetts cancer cases, 5.0% of male and 4.2% of female cases were lymphomas. In contrast, 18.7% of childhood and adolescent male cancer cases and 14.2% of childhood and adolescent female cases were lymphomas.
- Among all Massachusetts cancer cases, 1.4% of male and 1.3% of female cancer cases were CNS cancers. In contrast, 19.0% of childhood and adolescent male cases and 18.3% of childhood and adolescent female cases were CNS cancers.

The incidence rates of three cancers increased significantly among Massachusetts children and adolescents from 2000 to 2009.

The incidence rate of leukemia among Massachusetts children and adolescents increased significantly from 2000 to 2009, driven primarily by a significant increase in the incidence of acute lymphocytic leukemia (ALL). This significant trend was not found among either white non-Hispanics or Hispanics, the two racial/ethnic groups with a sufficient number of cases to perform a trend analysis. The leukemia increases, while significant, are still relatively small (leukemia increased from 2.8/100,000 to 3.5/100,000 over the ten years and acute lymphocytic leukemia increased from 3.7 to 4.3/100,000). The significant increase in Massachusetts rates of acute lymphocytic leukemia is consistent with significantly increasing rates at the national level. The American Cancer Society's publication on childhood leukemia notes the few known genetic and environmental factors associated with leukemia, emphasizing the fact that most adults and children with leukemia have no known risk factors. Lifestyle factors usually take many years to influence cancer risk and are usually not related to childhood and adolescent cancers.⁴

The incidence rates for lymphoma and Hodgkin lymphoma remained steady from 2000 to 2009, however, the incidence rate for non-Hodgkin lymphoma (NHL) increased significantly. While the overall trend for NHL was significant, examination of the trend line indicated a decrease in the rate until 2003 (1.2 to 0.6/100,000), followed by an increase from 2003 to 2007 (0.6 to 1.6/100,000), followed by a relative steadying of the trend in 2008 and 2009. The 2009 rate (1.4 per 100,000) is similar to the 2000 rate (1.2 per 100,000). National trends which rely

on larger numbers and more statistical power showed no significant trend in either direction from 2000 to 2009.

Thyroid cancer has been increasing at a significant rate primarily among adolescents ages 15 to 19. As noted earlier, this increase is consistent with the trend among the adult population in Massachusetts. While other risk factors may also be present, better detection of smaller tumors most likely has played a major role in this increase.¹²

In both Massachusetts and the US, mortality rates for all childhood and adolescent cancers decreased at a non-significant rate from 2000 to 2009, remaining around 2.5/100,000. Due to the limited number of deaths in Massachusetts, this report was able to compare mortality trends in Massachusetts with those of the US for only leukemia and CNS cancers. While the trends for leukemia decreased non-significantly in Massachusetts and significantly in the US, the trends remained stable for CNS cancers.

Massachusetts cause-specific five-year survival rates were comparable to and sometimes better than national percentages released by SEER. The higher survival rates in Massachusetts may be due in part to the higher number of cancer treatment facilities in the Commonwealth. Important to note is that the survival figures in this report are based on cancer types as a whole and do not control for co-morbidities, histological subtype, or the grade of cancer. A limitation of using cause-specific data is the inconsistent attribution of cancer as a cause of death when relying on death certificates and the exclusion of other causes of death possibly related to the cancer treatment. The American Cancer Society stresses that survival rates are 'based on previous outcomes of large numbers of children who had the disease, but they cannot predict what will happen in any particular child's case'.⁵ The heterogeneity and low incidence of childhood cancers greatly complicates attempts to determine causes for specific childhood cancers²². The survival times in this report should be interpreted as an overall assessment of past survival and not a specific predictor of individual survival. The decreased mortality rate of childhood cancer has been one of the major success stories of medicine in the last 30 years.

² Advances in treatment have contributed to the national five-year survival rates for all childhood cancers improving from 58.1% in 1975-1977 to 79.6% in 1996-2003²³ with survival rates for leukemias, Hodgkin disease, and sarcomas achieving notable improvements. Despite such progress, the Commonwealth must recommit to better understanding the causes of these childhood cancers, and provide improved treatments for those children and adolescents who face cancer at such a young age.

Appendix I
International Classification of Childhood Cancer, Third Edition (ICCC-3)
Based on ICD-O-3*

Site Group	ICD-O-2/ICD-O-3** codes	
	ICD-O-3 Histology (Type)	ICD-O-2/3 Site
I. Leukemias, myeloproliferative diseases, and myelodysplastic diseases		
a. Lymphoid leukemias	9820, 9823, 9826, 9827, 9831-9837, 9940, 9948	C000-C809
b. Acute myeloid leukemias	9840, 9861, 9866, 9867, 9870-9874, 9891, 9895-9897, 9910, 9920, 9931	C000-C809
c. Chronic myeloproliferative diseases	9863, 9875, 9876, 9950, 9960-9964	C000-C809
d. Myelodysplastic syndrome and other myeloproliferative diseases	9945, 9946, 9975, 9980, 9982-9987, 9989	C000-C809
e. Unspecified and other specified leukemias	9800, 9801, 9805, 9860, 9930	C000-C809
II. Lymphomas and reticuloendothelial neoplasms		
a. Hodgkin lymphomas	9650-9655, 9659, 9661-9665, 9667	C000-C809
b. Non-Hodgkin lymphomas (except Burkitt lymphoma)	9591, 9670, 9671, 9673, 9675, 9678-9680, 9684, 9689-9691, 9695, 9698-9702, 9705, 9708, 9709, 9714, 9716-9719, 9727-9729, 9731-9734, 9760-9762, 9764-9769, 9970	C000-C809
c. Burkitt lymphoma	9687	C000-C809
d. Miscellaneous lymphoreticular neoplasms	9740-9742, 9750, 9754-9758	C000-C809
e. Unspecified lymphomas	9590, 9596	C000-C809
III. Central nervous system and miscellaneous intracranial and intraspinal neoplasms		
a. Ependymomas and choroid plexus tumor	9383, 9390-9394	C000-C809
b. Astrocytomas	9380	C72.3
	9384, 9400-9441, 9420, 9421-9424, 9440-9442	C000-C809

* Chart from: Steliarova-Foucher E, Stiller C, Lacour B, Kaatsch P. International Classification of Childhood Cancer, 3rd Edition. *Cancer* 2005;103:1457-67.

** *International Classification of Diseases for Oncology, 2nd/3rd Ed.*

c. Intracranial and intraspinal embryonal tumors	9470-9474, 9480, 9508	C000-C809
	9501-9504	C700-C729
d. Other gliomas	9380	C700-C722, C724-C729, C751, C753
	9381, 9382, 9430, 9444, 9450, 9451, 9460	C000-C809
e. Other specified intracranial and intraspinal neoplasms	8270-8281, 8300, 9350-9352, 9360-9362, 9412, 9413, 9492, 9493, 9505-9507, 9530-9539, 9582	C000-C809
f. Unspecified intracranial and intraspinal neoplasms	8000-8005	C700-C729, C751-C753
IV. Neuroblastoma and other peripheral nervous cell tumors		
a. Neuroblastoma and ganglioneuroblastoma	9490, 9500	C000-C809
b. Other peripheral nervous cell tumors	8680-8683, 8690-8693, 8700, 9520-9523	C000-C809
	9501-9504	C000-C699, C739-C768, C809
V. Retinoblastoma	9510-9514	C000-C809
VI. Renal Tumors		
a. Nephroblastoma and other non-epithelial renal tumors	8959, 8964-8967	C000-C809
	8963, 9364	C649
b. Wilm's Tumor	8960	C000-C809
c. Renal carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8143, 8155, 8190-8201, 8210, 8211, 8221-8231, 8240, 8241, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8401, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8576	C649
	8311, 8312, 8316-8319, 8361	C000-C809
d. Unspecified malignant renal tumors	8000-8005	C649
VII. Hepatic Tumors		
a. Hepatoblastoma	8970	C000-C809
b. Hepatic carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8140, 8141, 8143, 8155, 8190-8201, 8210, 8211, 8230, 8231, 8240, 8241, 8244-8246, 8260-8264, 8310, 8320, 8323, 8401, 8430, 8440, 8480-	C220, C221

	8490, 8504, 8510, 8550, 8560-8576	
	8160-8180	C000-C809
c. Unspecified malignant hepatic tumors	8000-8005	C220, C221
VIII. Malignant Bone Tumors		
a. Osteosarcomas	9180-9187, 9191-9195, 9200	C400-C419, C760-C768, C809
b. Chondrosarcomas	9210, 9220, 9240	C400-C419, C760-C768, C809
	9221, 9230, 9241-9243	C000-C809
c. Ewing's tumors and related sarcomas of the bone	9260	C400-C419, C760-C768, C80.9
	9363-9365	C400-C419
d. Other specified malignant bone tumors	8810, 8811, 8823, 8830	C400-C419
	8812, 9250, 9261, 9262, 9270-9275, 9280-9282, 9290, 9330-9302, 9310-9312, 9320-9322, 9330, 9340-9342, 9370-9372	C000-C809
e. Unspecified malignant bone tumors	8000-8005, 8800, 8801, 8803-8805	C400-C419
IX. Soft tissue and other extraosseous sarcomas		
a. Rhabdomyosarcomas	8900-8905, 8910, 8912, 8920, 8991	C000-C809
b. Fibrosarcomas, peripheral nerve sheath tumors, and other fibrous neoplasms	8810, 8811, 8813-8815, 8821, 8823, 8834-8835	C000-C399, C440-C768, C809
	8820, 8822, 8824-8827, 9150, 9160, 9491, 9540-9571, 9580	C000-C809
c. Kaposi sarcoma	9140	C000-C809
d. Other specified soft-tissue sarcomas	8587, 8710-8713, 8806, 8831-8833, 8836, 8840-8842, 8850-8858, 8860-8862, 8870, 8880, 8881, 8890-8898, 8921, 8982, 8990, 9040-9044, 9120-9125, 9130-9133, 9135, 9136, 9141, 9142, 9161, 9170-9175, 9231, 9251, 9252, 9373, 9581	C000-C809
	8830	C000-C399, C440-C768, C809
	8963	C000-C639, C659-C699, C739-C768, C809
	9180, 9210, 9220, 9240	C490-C499,

	9260	C000-C399, C470-C759
	9364	C000-C399, C470-C639, C659-C699, C739-C768, C809
	9365	C000-C399, C470-C639, C659-C768, C809
e. Unspecified soft-tissue sarcomas	8800-8805	C000-C399, C440-C768, C809
X. Germ cell tumors, trophoblastic tumors, and neoplasms of gonads		
a. Intracranial and intraspinal germ cell tumors	9060-9065, 9070-9072, 9080-9085, 9100, 9101	C700-C729, C751-C753
b. Malignant extracranial and extragonadal germ cell tumors	9060-9065, 9070-9072, 9080-9085, 9100-9105	C000-C559, C570-C619, C630-C699, C739-C750, C754-C768, C809
c. Malignant gonadal germ cell tumors	9060-9065, 9070-9073, 9080-9085, 9090, 9091, 9100, 9101	C569, C620-C629
d. Gonadal carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8143, 8190-8201, 8210, 8211, 8221-8241, 8244-8246, 8260-8263, 8290, 8310, 8313, 8320, 8323, 8380-8384, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8573, 9000, 9014, 9015	C569, C620-C629
	8441-8444, 8450, 8451, 8460-8473	C000-C809
e. Other and unspecified malignant gonadal tumors	8590-8671	C000-C809
	8000-8005	C569, C620-C629
XI. Other malignant epithelial neoplasms and malignant melanomas		
a. Adrenocortical carcinomas	8370-8375	C000-C809
b. Thyroid carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8190, 8200, 8201, 8211, 8230, 8231, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440,	C739

	8480, 8481, 8510, 8560-8573	
	8330-8337, 8340-8347, 8350	C000-C809
c. Nasopharyngeal carcinomas	8010-8041, 8050-8075, 8082, 8083, 8120-8122, 8130-8141, 8190, 8200, 8201, 8211, 8230, 8231, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440, 8480, 8481, 8550-8576	C110-C119
d. Malignant melanomas	8720-8780, 8790	C000-C809
e. Skin carcinomas	8010-8041, 8050-8075, 8078, 8082, 8090-8110, 8140, 8143, 8147, 8190, 8200, 8240, 8246, 8247, 8260, 8310, 8320, 8323, 8390-8420, 8430, 8480, 8542, 8560, 8570-8573, 8940, 8941	C440-C449
f. Other and unspecified carcinomas	8010-8084, 8120-8157, 8190-8264, 8290, 8310, 8313-8315, 8320-8325, 8360, 8380-8384, 8430-8440, 8452-8454, 8480-8586, 8588-8589, 8940, 8941, 8983, 9000, 9010-9016, 9020, 9030	C000-C109, C129-C218, C239-C399, C480-C488, C500-C559, C570-C619, C630-C639, C659-C729, C750-C768, C809
XII. Other and unspecified malignant neoplasms		
a. Other specified malignant tumors	8930-8936, 8950, 8951, 8971-8981, 9050-9055, 9110	C000-C809
	9363	C000-C399, C470-C759
b. Other unspecified malignant tumors	8000-8005	C000-C218, C239-C399, C420-C559, C570-C619, C630-C639, C659-C699, C739-C750, C754-C809

Appendix II
ICD-9 * and ICD-10* Codes

Cancer site/type	ICD-9 code	ICD-10 code
Bone	170	C40-C41
Brain & Central Nervous System	191-192	C70-C72
Kidney	189.0-189.1	C64-C65
Leukemia	204-208	C91-C95
Liver	155	C22.0, C22.2-C22.4, C22.7, C22.9
Lymphoma	200, 201, 202.0-202.2, 202.8-202.9	C81, C82-C85, C96.3
Melanoma/Skin	172-173	C43, C44, C46+
Thyroid	193	C73

* *International Classification of Diseases, Ninth Revision, Clinical Modification*

* *International Classification of Diseases, Tenth Revision, Clinical Modification*

Appendix III: Childhood and Adolescent Cancer Counts, 2000-2009

All Cancers:	Male	Female			
2000	157	136			
2001	137	134			
2002	149	123			
2003	140	155			
2004	173	122			
2005	158	142			
2006	185	165			
2007	162	133			
2008	154	153			
2009	188	135			
2000-2009	1603	1398			
All Cancers:	0-4	5-9	10-14	15-19	
2000	91	50	58	94	
2001	88	45	56	82	
2002	68	54	57	93	
2003	99	55	50	91	
2004	100	43	58	94	
2005	84	36	64	116	
2006	108	60	62	120	
2007	83	52	60	100	
2008	92	46	52	117	
2009	101	49	48	125	
2000-2009	914	490	565	1032	
All Cancers:	White, NH	Black, NH	Asian, NH	Hispanic	
2000	237	21	9	17	
2001	220	18	7	20	
2002	225	16	7	21	
2003	243	14	5	28	
2004	236	14	5	32	
2005	240	15	18	20	
2006	279	19	13	34	
2007	229	17	13	29	
2008	239	18	8	37	
2009	239	23	23	34	
2000-2009	2387	175	108	272	
Leukemia:	Total	ALL	AML		
2000	62	46	13		
2001	59	45	8		
2002	73	53	14		
2003	68	55	9		
2004	74	54	15		
2005	73	60	11		
2006	76	58	10		
2007	69	54	12		
2008	82	66	14		
2009	69	57	9		
2000-2009	705	548	115		

Lymphoma:	Total	HL	NHL		
2000	50	27	20		
2001	43	23	14		
2002	37	18	14		
2003	44	29	9		
2004	45	25	16		
2005	61	32	18		
2006	64	34	19		
2007	49	17	27		
2008	49	21	22		
2009	57	26	23		
2000-2009	499	252	182		
CNS:	Total	Astrocytoma	Embryonal		
2000	59	29	13		
2001	60	31	13		
2002	45	22	8		
2003	55	33	10		
2004	67	33	15		
2005	55	30	9		
2006	61	30	11		
2007	55	29	9		
2008	49	19	14		
2009	57	24	9		
2000-2009	563	280	111		
Peripheral NC:	Total	Neuroblastoma			
2000	23	23			
2001	23	22			
2002	20	20			
2003	19	19			
2004	15	15			
2005	9	8			
2006	20	20			
2007	27	27			
2008	19	19			
2009	20	20			
2000-2009	195	193			
Renal Tumors:		Bone Tumors:		Soft Tissue:	
2000	14	2000	15	2000	22
2001	10	2001	8	2001	21
2002	10	2002	11	2002	19
2003	16	2003	15	2003	30
2004	8	2004	9	2004	16
2005	6	2005	16	2005	20
2006	8	2006	22	2006	23
2007	5	2007	11	2007	24
2008	13	2008	8	2008	21
2009	19	2009	9	2009	16
2000-2009	109	2000-2009	124	2000-2009	212

Germ Cell Tumor:					
2000	15				
2001	13				
2002	22				
2003	12				
2004	20				
2005	12				
2006	19				
2007	13				
2008	22				
2009	26				
2000-2009	174				
Epithelial Tumor:	Total	Melanoma	Thyroid		
2000	25	7	9		
2001	26	8	10		
2002	33	12	15		
2003	28	10	8		
2004	31	13	12		
2005	35	8	21		
2006	42	12	17		
2007	37	14	14		
2008	38	10	24		
2009	38	13	16		
2000-2009	333	107	146		
2000-2009 Cases:	Male	Female			
Leukemia	379	326			
Lymphoma	300	199			
CNS	304	256			
PNC	107	88			
Retinoblastoma	17	25			
Renal Tumors	53	56			
Hepatic Tumors	18	15			
Bone Tumors	72	52			
Soft Tissue	119	93			
Germ Cell	108	66			
Epithelial Tumor	120	213			
Other	6	9			
All Cancers	1603	1398			
2000-2009 Cases:	0-4	5-9	10-14	15-19	
Leukemia	330	131	115	129	
Lymphoma	26	62	141	270	
CNS	180	162	111	107	
PNC	158	22	10	5	
Retinoblastoma	41	0	<5	0	
Renal Tumors	68	30	7	<5	
Hepatic Tumors	26	<5	<5	<5	
Bone Tumors	5	20	55	44	
Soft Tissue	46	38	35	93	
Germ Cell	27	12	20	115	
Epithelial Tumor	<5	10	66	256	
Other	6	<5	<5	6	
	914	490	565	1032	

2000-2009 Cases:	White, NH	Black, NH	Asian, NH	Hispanic	Other/Unknown
Leukemia	551	33	31	82	8
Lymphoma	398	35	19	43	<5
CNS	463	23	19	46	9
PNC	162	10	6	15	<5
Retinoblastoma	30	<5	0	5	<5
Renal Tumors	89	12	<5	6	<5
Hepatic Tumors	19	<5	<5	7	0
Bone Tumors	99	10	5	9	<5
Soft Tissue	155	23	8	21	5
Germ Cell	146	5	7	12	<5
Epithelial Tumor	265	14	7	25	22
Other	10	<5	<5	<5	0
	2387	175	108	272	59
Cancer Deaths:	Total	Leukemia	CNS		
2000	49	15	15		
2001	38	7	7		
2002	37	8	9		
2003	43	13	8		
2004	36	11	8		
2005	36	10	6		
2006	33	10	8		
2007	40	13	11		
2008	42	11	9		
2009	32	9	10		
2000-2009	386	107	91		

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